POPULAR SCIENCE

15¢ JAN. 20¢ IN CANADA

How Canada Fights Hitler

PAGE 96

OPPORTUNITIES FOR AIR CORPS CAREERS

PAGES 63 AND 90

YOUR PLANES

YOUR SHIPS

YOUR TANKS

THE UNITED STATES GOVERNMENT is again using "Prestone" anti-freeze to provide one-shot protection for Army and Navy equipment.

Your planes, your ships, your tanks, squad cars, trucks and torpedo patrol boats will be protected by the anti-freeze that does not boil away. They will be protected by the *guaranteed* anti-freeze that outlaws freeze-up, rust and corrosion . . . the one-shot anti-freeze that protects all winter long.

If you can't get "PRESTONE" anti-freeze *REMEMBER THIS*—

In addition to Government demands made on the finished product, "Prestone" anti-freeze, thousands of tons of raw materials necessary for its manufacture are now being used in making vital defense equipment of many different kinds.

Some of the important uses to which these raw materials are being put were born in the laboratory but a short time ago.

Despite these heavy defense requirements, quantities of "Prestone" anti-freeze were made available to American motorists, but the supply probably will not be sufficient to meet all civilian needs.

"PRESTONE" ANTI-FREEZE

NATIONAL CARBON COMPANY, INC.
Unit of Union Carbide and Carbon Corporation

UCC

The word "Prestone" is a registered trade-mark of National Carbon Company, Inc.

GET IN STEP—NOW!

WITH U. S. DEFENSE

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

TODAY, the *trained man in industry* marches shoulder-to-shoulder with America's armed forces in defense of his country! The man who wilfully neglects his training is a *slacker*—for Uncle Sam expects every one of us to "get in step," and help out-produce the gangster nations of the world!

Would sound, practical, modern training help you do *your* part better? Then mail this coupon, and learn how an I. C. S. Course in your line of work will prepare you for the bigger opportunities that lie ahead—fit you for *success!* You'll be surprised to find how little it costs to become a trained man the I. C. S. way!

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 7423-K, SCRANTON, PENNA.

★ Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course *before* which I have marked X: ★

TECHNICAL AND INDUSTRIAL COURSES

☐ Air Brake	☐ Contracting and Building	☐ Marine Engines	☐ Sanitary Engineering
☐ Air Conditioning	☐ Cotton Manufacturing	☐ Mechanical Drafting	☐ Sheet Metal Work
☐ Airplane Drafting	☐ Diesel Engines	☐ Mechanical Engineering	☐ Ship Drafting
☐ Architectural Drafting	☐ Electrical Drafting	☐ Mine Foreman	☐ Shipfitting ☐ Shop Practice
☐ Architecture	☐ Electrical Engineering	☐ Navigation	☐ Steam Electric ☐ Steam Engines
☐ Auto Engine Tune-up	☐ Electric Lighting	☐ Patternmaking ☐ Plumbing	☐ Steam Fitting
☐ Auto Technician	☐ Foundryman ☐ Heating	☐ Practical Telephony	☐ Structural Drafting
☐ Aviation ☐ Aviation Mechanic	☐ Heat Treatment of Metals	☐ Public Works Engineering	☐ Structural Engineering
☐ Boilermaking	☐ Highway Engineering	☐ Pulp and Paper Making	☐ Surveying and Mapping
☐ Bridge Engineering	☐ House Planning	☐ Radio, General	☐ Telegraph Engineering
☐ Chemistry	☐ Industrial Metallurgy	☐ Radio Operating	☐ Telephone Work
☐ Civil Engineering	☐ Locomotive Engineer	☐ Radio Servicing	☐ Textile Designing
☐ Coal Mining	☐ Machinist	☐ R. R. Section Foreman	☐ Toolmaking ☐ Welding
☐ Concrete Engineering	☐ Management of Inventions	☐ R. R. Signalman ☐ Refrigeration	☐ Woolen Manufacturing

BUSINESS COURSES

☐ Accounting ☐ Advertising	☐ College Preparatory	☐ First Year College	☐ Railway Postal Clerk
☐ Bookkeeping	☐ Commercial	☐ Foremanship ☐ French	☐ Salesmanship
☐ Business Correspondence	☐ Commercial Illustrating	☐ Good English	☐ Secretarial ☐ Spanish
☐ Business Management	☐ Cost Accounting	☐ High School	☐ Showcard and Sign Lettering
☐ Cartooning ☐ Civil Service	☐ C. P. Accounting	☐ Managing Men at Work	☐ Traffic Management

HOME ECONOMICS COURSES

☐ Advanced Dressmaking	☐ Home Dressmaking	☐ Tea Room and Cafeteria Management, Catering
☐ Foods and Cookery	☐ Professional Dressmaking and Designing	

Name..... Age..... Address.....

City..... State..... Present Position.....

Canadian residents send coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada
British residents send coupon to I. C. S., 71 Kingsway, London, W. C. 2, England

IMPROVE YOUR HOME . . . NOW

Popular Science *Announces* a complete program for the repair, renovation, and upkeep of American homes ★ ★ ★ ★

OUR homes never meant more to us than they do today. They are our one refuge from the pressure of world-rending events . . . our one escape from the desperate tempo of industrial mobilization. Let's make them more comfortable to live in. Let's improve them . . . now!

The time is perhaps better than you think. It's true that there are serious shortages of certain materials, especially metals required for new construction. But lumber, cement, wall boards, plywood, insulation, plaster, paints, glass, and many types of basic materials are obtainable for repairs and renovation. More money, too, is available—in spite of sharply increased taxes—because jobs are plentiful and the national income is soaring to an all-time high. And what better, safer way could there be to spend part of it than on home modernization? The virtual cessation of new building in all but defense areas or on defense projects also has had the effect of freeing much skilled labor for remodeling and repair work. All in all, it's an opportunity to seize . . . *your* opportunity.

The first thing to do is to survey your house carefully and plan to correct its defects and deficiencies. To aid in this, POPULAR SCIENCE, beginning next month, will present during 1942 a complete, extensive, and authoritative series of articles on home repairs and maintenance.

In this program you are certain to find ideas that will help you improve your home. Time and money spent in this way will pay lavish dividends in comfort, satisfaction, enhanced property value. There never was . . . and never will be . . . any better investment than your own home.

Popular Science Monthly for January, 1942. Volume 140, Number 1. Published monthly at 353 Fourth Avenue, New York, N. Y., by Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 25, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Yearly subscriptions to the United States, $1.50.

The SOLDIER TRAINS FOR *HIS* SERVICE—

Photo courtesy of U. S. Army Signal Corps

ARE *YOU* ➡➡➡➡➡➡➡➡➡➡➡➡ TRAINING FOR *YOURS?*

NEARLY 2,000,000 men are training in our armed services—developing their ability to serve our nation better. Millions more of us have just as great a duty to train for our part in civilian service—to develop our talents in office, store and factory—so that we may back that soldier better. Our nation needs our utmost capacity, the best that we can be and do.

That training must be quick, thorough, practical—you cannot wait on slow day by day experience—you must have that, and much more.

Fortunately, for 33 years LaSalle has been developing spare time training that fits this crisis exactly. It condenses the best experience of successful men; it gives you the boiled down rules and principles and teaches you to use them effectively; what you study at home tonight, you can use on the job tomorrow. It is home study, so you lose no time from your daily work. It is moderate in cost and easy payment terms are available. It means better service, new and larger lifetime success for you.

If you are serving—or wish to serve—in one of the fields listed below, ask for the facts about that field and our proved spare time training for it.

LASALLE EXTENSION UNIVERSITY *A Correspondence Institution*

Dept. 183-R CHICAGO, ILLINOIS

Please send me your free 48-page booklet about the opportunities and requirements in the field I have checked below; also full details about your training in that field —all without obligation to me.

☐Accounting	☐Expert Bookkeeping	☐Salesmanship
☐Industrial Management	☐Effective Speaking	☐Law
☐Traffic Management	☐Business English	☐Business Law
☐Business Correspondence	☐Foremanship	☐Stenotypy

Name..... *Age*.....

Present Position.....

Address .....

POPULAR SCIENCE

FOUNDED 1872 MONTHLY VOL. 140 NO. 1

Mechanics & Handicraft

THE NEWS PICTURE MAGAZINE OF SCIENCE AND INDUSTRY

CONTENTS *for* JANUARY, 1942

News

Automobiles

Home and Workshop

Departments

DAVID MARSHALL ("Model-Railway Notes," page 184) is a New York City newspaper man who became a specialist on railroad engineering problems and was graduated into model railroading by that unusual route. Experts who have seen the manuscript of his book, "Model Railroad Engineering," to be published in January, call it the best ever written on the subject.

Published monthly at 353 Fourth Avenue, New York, N. Y., by Popular Science Publishing Co., Inc. Godfrey Hammond, President and Treasurer; R. C. Wilson, Raymond J. Brown, Vice Presidents; F. W. Briggs, Secretary. Entered as second-class matter Dec. 28, 1915, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A.

Single copy, 15 cents; Canada, 20 cents. Yearly subscriptions in United States and its possessions, $1.50; Canada, $2.00; foreign countries, excepting Canada, $2.50. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address.

That's the situation your telephone company faces every Christmas. That's why there may be delays on some Long Distance Christmas calls.

• Last Christmas Eve and Day the wires were jammed. The switchboards were manned by regular and extra operators working all through the holiday. Long Distance telephone calls were three, five and at some places *eight* times normal.

We're glad so many folks want to exchange friendly greetings across the miles at Christmas — but sorry that, because of it, we can't supply service as good as usual.

We expect the biggest rush of calls we've ever had this coming Christmas. We'll do our best to prepare for it. But some calls will be slow. Some may not be completed. For these, we ask your patience and understanding. *Thank you.*

BELL TELEPHONE SYSTEM

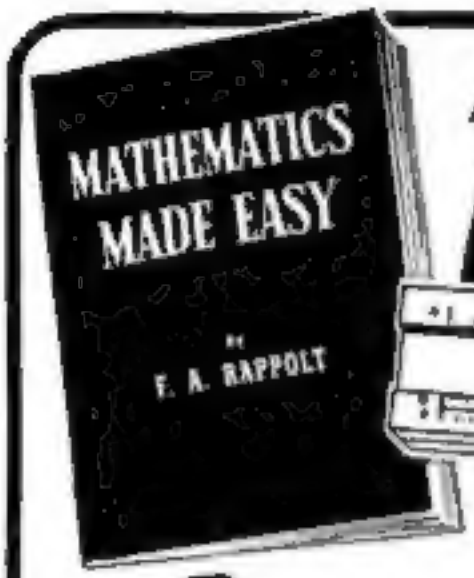
Contents [CONTINUED]

Automobiles

Aviation

Facts and Ideas

(Continued on page 8)



FREE!

THIS VALUABLE NEW BOOK—"Mathematics Made Easy." Gives you simplified instruction in every phase of calculating in ALL types of work. PLUS a FREE DeLuxe Professional 10-inch SLIDE RULE. Saves time, simplifies all calculations, fractions, estimating, percentages, decimals, costs, ratios, etc., etc. With complete instructions for using a Slide Rule. Both ABSOLUTELY FREE.

if you want

A BETTER JOB and BIGGER PAY

Learn

Thru New "SHADOWGRAPH" Method You Read Blueprints the First Day

BLUEPRINT READING

AMAZING NEW INVENTION

Makes Blueprint Reading Easy as Seeing a Movie

Learn at Home—EASILY, QUICKLY—IN SPARE TIME

THOUSANDS OF MEN WANTED—AT ONCE!

MEN of ALL AGES and ALL TRADES

If you are a

Mechanic, Student, Welder, Carpenter, Plumber, Shipbuilder, Machinist, Sheet-Metal Worker, Tool Maker, Electrician, Aviation Mechanic, etc.

you must know BLUEPRINT READING to win promotion and bigger pay

Better Jobs—Bigger Pay are waiting for men who can READ BLUEPRINTS. Here, at last, is a new quick and easy shortcut way to learn Blueprint Reading at Home in an amazingly short time—at an unbelievably low cost. This sensational "Shadowgraph" Method of Blueprint Reading was created by Nationally Famous Experts—skilled in teaching technical subjects to men without previous technical education. They have eliminated all complicated details, they explain all technical words in simple language. Contains everything you need to know about Reading Blueprints—no matter what kind of work you do.

NOW ANYONE CAN READ BLUEPRINTS

Everything about Blueprint Reading is put right at your finger-tips! Simple as A B C. No need to attend an expensive trade or technical school. No previous technical or special education is needed. Here's a speedy Blueprint Reading Course for all trades that is ABSOLUTELY different. No dry text-books—you learn by **seeing** and **doing**—and you READ BLUEPRINTS from the very FIRST DAY. With this amazing new method—a few minutes a day is all you need to read Blueprints on sight. This simplified, spare-time, Home Study Course meets all Blueprint Requirements for Civil Service and National Defense Jobs.

CREATED BY NOTED EXPERTS

H. V. WALSH, B. A., Professor, Columbia, 1919-1935; F. A. RAPPOLT, B. S., C. E., Prof., School of Tech., City College, N. Y.; P. E. BURNS, B. S., M. E., Prof., Newark Col. of Engineering.

QUALIFY QUICKLY FOR A BIG PAY JOB

Here is really big news for you—if you have a job, or if you want a job in any branch of aviation, shipbuilding, sheet-metal work, welding, electricity, machine tooling, plumbing, carpentry, radio, building, automotive and Diesel Engineering, or any other of the mechanical, construction or DEFENSE INDUSTRIES—the Austin Tech "Shadowgraph" Method CAN HELP YOU QUALIFY for a BETTER JOB AND BIGGER PAY in an amazingly short time. This marvelous home-study method is so easy—it enables even a school boy to learn Blueprint Reading from the first day!

This 24-Volume Blueprint Reading Course is packed in a specially constructed bookcase, which in itself is a unique "Working Model" designed to enable you to read Blueprints from the first day. The Course contains over 600 Actual Blueprints—Charts—Tables—Diagrams—Signs—Symbols and other Instructive Pictures that help you to read Blueprints practically on sight.

EVERYTHING IS SENT TO YOU AT ONCE!

The complete 24-Volume Blueprint Reading Course is sent to you together with the specially constructed "Working Model" Bookcase. You also get FREE—"Mathematics Made Easy" and Professional Slide Rule. Everything is sent in one shipment. ACT TODAY—DUE TO RISING PRICES, FREE GIFT OFFER IS LIMITED.

AUSTIN TECHNICAL INSTITUTE, 899 Broad Street, Div. P.S.-1, Newark, N. J.

FREE EXAMINATION

AUSTIN TECHNICAL INSTITUTE
899 Broad St., Div. P.S.-1, Newark, New Jersey

Send me on FREE APPROVAL your complete 24-Volume Blueprint Reading Course with special "Working Model" Bookcase. I am to get FREE "Mathematics Made Easy" and Professional Slide Rule. I will pay postman $1.95, plus postage and C.O.D. charges on arrival. If I return everything within 5 days you are to refund my money in full. Otherwise I will remit $2.00 monthly for 3 months and a final payment of $1, for the 4th month until the total price of $8.95 is paid. (10% discount if full payment accompanies order—same refund guaranteed.)

Name .....

Address .....

City ..... State .....

Reference .....

Address .....

NOTE: If you enclose $1.95 with coupon—we will pay all postage charges. Every cent refunded if not satisfied.

SEND NO MONEY

Contents [CONTINUED]

Inventions

Craftwork

Home Building

Miscellaneous

New Shop Ideas

(Continued on page 12)

I Jumped from $18 a Week to $50 -a Free Book started me toward this GOOD PAY JOB IN RADIO

Here's how I did it

by S. J. E.
(NAME AND ADDRESS SENT UPON REQUEST)

"I had an $18 a week job in a shoe factory, but desired to make more money and continue my education. I read about Radio opportunities and enrolled with the National Radio Institute."

"The instruction I received was so practical I was soon able to earn $5 to $10 a week in spare time servicing Radios. This paid for the N R I Course and led to service work paying for my college education."

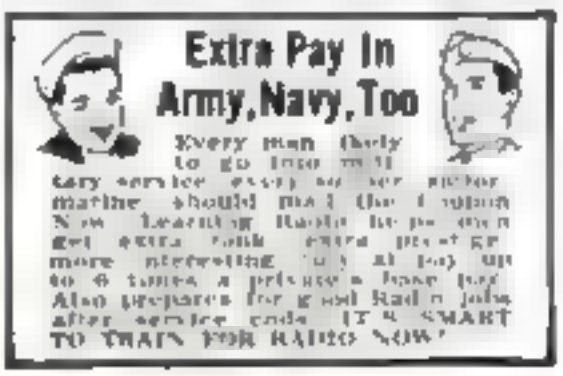
Find out today How I Train You at Home to BE

J. E. SMITH, President National Radio Institute Established 25 Years

Here is a quick way to more pay. Radio offers the chance to make $5, $10 a week extra in spare time a few months from now. There is an increasing demand for full time Radio Technicians and Radio Operators too. Many make $30, $40, $50 a week. On top of record business the Radio Industry is getting millions and millions of dollars in Defense Orders. Clip the coupon above and mail it. Find out how I train you for these opportunities.

Why Many Radio Technicians I Train Make $30, $40, $50 a Week

The 882 broadcasting stations in the U. S. employ thousands of Radio Technicians with average pay among the country's best paid industries. Repairing, servicing selling home and auto Radio receivers



(there are over 50,000,000 in use) gives good jobs to thousands. Many other Radio Technicians take advantage of the opportunities to have their own service or retail Radio businesses. Think of the many good pay jobs in connection with Aviation, Commercial, Police Radio and Public Address Systems. N R I gives you the required knowledge of Radio for these jobs. N. R. I trains you to be ready when Television opens new jobs. Yes, Radio Technicians make good money because they use their heads as well as their hands. They must be trained. Many are getting special ratings in the Army and Navy; extra rank and pay.

PARKS AIR COLLEGE

PARKS AIRPORT — EAST ST. LOUIS, ILL.

Offers YOU COLLEGE and PROFESSIONAL TRAINING Majoring in AVIATION

Accredited by the Illinois Superintendent of Public Instruction. Included in the Accredited Higher Institutions 1938, issued by the U. S. Office of Education, Federal Security Agency. U. S. approved as a Commercial Ground and Flying School and Mechanics School. Accredited by and cooperating with the United States Army Air Corps in giving flight and mechanical training. Open to high school graduates. **FOUR courses lead to B. S. degrees in Professional Piloting, Aviation Operations, Maintenance Engineering, Aeronautical Engineering.**

TWENTY-TWO TRAINING PLANES are used in professional flight training which prepares graduates for airline flight operations. FACULTY of 31 specialists in various fields of aviation.

1569 graduates. Enrollment limited to a total of 300 commercial aviation students. Capacity enrollment of 360.

100-acre airport, 25 buildings devoted to school purposes exclusively. Dormitories and dining hall at the College.

Spring term March 30. Send postcard for new 64-page catalog.

15th YEAR Registrar, Dept. PS-1 PARKS AIR COLLEGE, East St. Louis, Ill.

Foremen!

Increase Your Pay

No matter how many years you've been on the job you'll find LaSalle home-study training in Modern Foremanship a real money-maker for you. Here's why: Hugo Diemer, Meyer Bloomfield and a number of other experts who had won distinction in the field of production engineering gathered, analyzed and organized for LaSalle the experience of *more than 5,000 practical foremen and production men in every line of industry.* Upon this basic material they built a truly remarkable training course covering every phase of the foreman's job. "Have received two promotions and a 'raise' in salary of $75 a month." "Have increased the production of my department 20%." "My monthly salary is now $510—a raise of $125 a month." These are but a few of the many tributes paid LaSalle home-study training in Modern Foremanship. Low cost, easy terms. Complete details in an attractive 48-page book, "Modern Foremanship." Sent you free upon request. Write for it today.

LASALLE EXTENSION UNIVERSITY
A Correspondence Institution
Dept. 183-MF CHICAGO

Contents [CONTINUED]

Outdoors

Photography

Radio

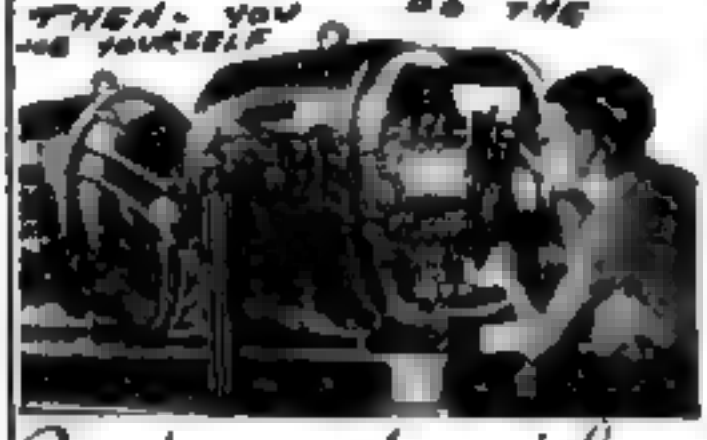
Shop Data File

The Handy Man

Woodworking

I'VE GOT AN AMAZINGLY EASY WAY TO GET INTO ELECTRICITY AND "I'll Finance your training".

FIRST - YOU ARE TOLD AND SHOWN HOW TO DO IT.



THEN - YOU DO THE JOB YOURSELF

Prepare for jobs like these.

ARMATURE WINDER
SUB-STATION OPERATOR
AUTOM AVIATION IGNITION
MAINTENANCE ELECTRICIAN
SERVICE STATION OWNER
AIR CONDITIONING
ELECTRIC REFRIGERATION
RADIO SERVICING
AND MANY OTHERS

Get my story.

I DON'T EMPLOY SALESMEN - I SEND YOU THE FACTS AT NO OBLIGATION.

Radio

RIGHT NOW I'M INCLUDING WITH MY REGULAR ELECTRICAL COURSE AN EXTRA 4 WEEKS' RADIO COURSE AT NO EXTRA TUITION CHARGE

mail today

COYNE ELECTRICAL SCHOOL 500 So. PAULINA ST. CHICAGO, ILLINOIS DEPT. 12-73

"Learn By Doing" - in 90 Days

LACK OF EXPERIENCE - AGE, OR EDUCATION BARS NO ONE. I DON'T CARE IF YOU DON'T KNOW AN ARMATURE FROM AN AIR BRAKE - I DON'T EXPECT YOU TO! IT MAKES NO DIFFERENCE!

Earn While Learning

PART TIME WORK TO HELP PAY LIVING EXPENSES IF YOU NEED IT.

Graduate Employment Service

AFTER GRADUATION YOU WILL GET EMPLOYMENT HELP, CONSULTATION HELP, AND MANY OTHER SERVICES TO HELP YOU MAKE A SUCCESS OF YOUR TRAINING.

Not Books - Not Lessons

YOU ARE TRAINED - NOT BY BOOKS OR PRINTED LESSONS BUT ON ACTUAL ELECTRICAL MACHINERY - YOU GET INDIVIDUAL TRAINING. ALL ACTUAL WORK - BUILDING REAL BATTERIES - WINDING REAL ARMATURES - OPERATING REAL MOTORS, DYNAMOS AND GENERATORS, WIRING HOUSES, ETC.

Easy to Learn - Easy to Pay

YOU'LL BE AMAZED HOW LITTLE MONEY YOU NEED TO GET COYNE TRAINING. YOU CAN GET THIS TRAINING FIRST AND PAY FOR IT IN 12 MONTHLY PAYMENTS, BEGINNING 60 DAYS AFTER YOUR TRAINING PERIOD ENDS.

Mail the Coupon now for big free book and all the details. — H. C. Lewis

H. C. LEWIS, PRES., COYNE ELECTRICAL SCHOOL
500 So. PAULINA ST. DEPT. 12-73, CHICAGO, ILL.

PLEASE SEND ME YOUR BIG FREE BOOK AND ALL THE FACTS ABOUT COYNE, AND YOUR PLANS TO HELP FELLOWS LIKE ME TO GET AHEAD.

NAME .....

ADDRESS .....

CITY ..... STATE .....

Coming Next Month—

BULL'S-EYES MEAN NOTHING to a flight archer; he shoots for distance. To squeeze out the extra foot or inch that may mean a record, he builds his own tackle—bows embodying tricks used by the medieval Turks, featherweight arrows, bowstrings so fragile that they explode after the first shot. "Secrets of the Flight Archers" tells all about this most exacting form of bow-and-arrow sport.

HORSE EARNS $60,000! Not a racing champion or a movie cowboy's mount, but one of the hundreds of animals that are saving human lives by lending their bodies for the making of priceless serum. Read about these four-footed benefactors of mankind and the pampered life they lead on a modern laboratory farm.

TIME FOR A GAME of checkers, cards, or backgammon? Soldiers in camp, sailors at sea, defense workers away from home will find plenty of use for the portable game kit described in the February issue. It's easy to make from the detailed plans, and buying the materials won't make a dent in a buck private's pay.

ARMY TEST PILOTS are the cream of the Air Corps' flyers—men picked because they have a natural knack for handling planes. And they have to be good, because it's their job to put the new warplanes through their paces and find out just what they can do. You'll be thrilled by Hickman Powell's story of the men who are ready to fly anything that has wings—and the more power the better!

THEY KNOW TIRES, because they are paid to wear them out. They are the test-car drivers for the big tire companies, and they can give a piece of rubber more punishment in a few days than you and your jallopy can give it in a year. For the same reason, they can tell you what NOT to do if you're trying to save tires instead of ruin them. You'll find it all in "Tire Tips from Test Car Drivers."

NOW IS THE TIME to make any necessary repairs on your home, or to add any improvements. With new building practically at a standstill and serious shortages of materials and labor in prospect, you can't afford to put things off. Beginning a series of articles on home repair and modernization, a general survey helps you make a point-by-point check of the things you should do—NOW!

INVENTORS

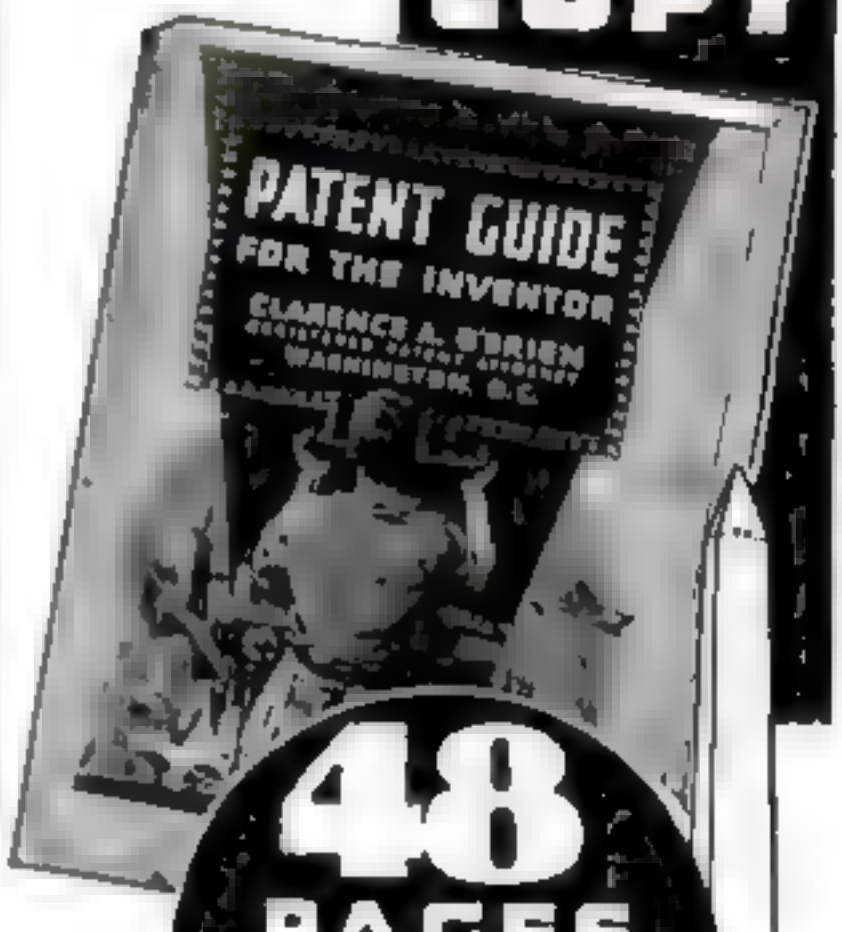
Get Expert Advice on HOW to PROTECT and SELL Your Invention

Get FREE COPY

WE GIVE SPECIAL ATTENTION TO DEFENSE INVENTIONS

Due to the essential nature of inventions which might be considered of value to the National Defense, we are giving special attention to such matters. Ever in the event of assisting in submitting your invention to the proper authorities.

"Why I thought of that years ago!" How many persons have said that, when they found later that somebody else had thought of the same thing, had it patented, sold it, and were profiting from it? Too many, sad to say. These unfortunates did not know what to do about their inventions, in order to protect and profit from them. Some thought elaborate working models were necessary to secure a patent—others felt their idea wasn't "worth much." They failed to realize that a good practical invention, plus prompt action in securing a Patent, and locating a buyer or a good market, have proved the secrets of success for thousands of inventors.



Patent Guide Shows What To Do

Our "Patent Guide for the Inventor" answers many important questions concerning Patents that inventors constantly ask. It tells what facts, details, drawings, sketches, etc are necessary to apply for a Patent, how to protect your invention through dated and witnessed disclosure, how to do this AT ONCE to safeguard your rights, how Patent Office Records can be checked to determine whether the invention is probably patentable before filing fees need be paid; discusses costs involved and a practical way these can be paid as the application progresses. It tells how some inventors secured financial backing, how many simple inventions have proved large commercial successes, how Patents covering improvements also can be profitably utilized and marketed, tells countless other facts of interest.

48 PAGES Over 100 Illustrations

Why You Need Expert Assistance

The Patent Laws were enacted for your benefit—to give you protection for the features of your invention which are Patentable. But these features must be legally and concisely set forth in the form of "claims." This phase of the procedure is so complex that the Patent Office advises the Inventor to engage a competent Registered Patent Attorney. We maintain a large staff—carefully trained registered patent attorneys—expert draftsmen—experienced searchers—to serve you. We have been serving inventors for more than 20 years.

Take First Step Now

With the Patent Guide you will receive also Free a "Record of Invention" form which will enable you at once to establish the date of your invention, before you file your Patent application. This step costs you nothing yet may be vital to your success. Remember—in Patent Matters, ACTION is IMPORTANT. Delay can be costly. Mail the coupon in an envelope, or paste it on a penny postcard NOW.

Get This FREE BOOK

IMMEDIATELY MAIL COUPON TODAY!

CLARENCE A. O'BRIEN
"Worthy of Your Trust"
Registered
[redacted] Attorney
Washington, D. C.

CLARENCE A. O'BRIEN
CLARENCE A. O'BRIEN
Registered Patent Attorney before the United States Patent Office
22-A Adams Building, Washington, D. C.

Please send me your 48-Page "Patent Guide" and your specially prepared "Record of Invention" form FREE. This request does not obligate me.

Name.....

Address.....

City.....State.....

(Please write or print plainly)

OBJECTIONABLE FUMES known as mercaptans have been a headache to gasoline refiners. They caused unpleasant smells, and they neutralized the effectiveness of Ethyl fluid. Atlantic Refineries recently solved the problem by introducing a solvent made of water, caustic soda, and methanol which acts like a dry cleaner in removing the odors but has no effect on the stability or anti-knock properties of the gasoline.

From the News Editor's Desk

SILVER AND ALUMINUM make the best coatings for mirrors, of the 37 different metals tested in recent experiments at the General Electric Research Laboratory. The metal coatings on glass were applied in a vacuum chamber by evaporating the metal from an electric filament. The silver coating reflected about 95 percent and the aluminum about 88 percent. When two percent of copper was added, the aluminum reflected about 90 percent.

METAL MANUFACTURERS will be doing the U. S. Secret Service a favor if they report any orders for spring-tempered "gilding metal" (97 percent copper, three percent zinc, rolled in sheets 4 100 of an inch thick and cut into strips 1⅝ inches wide. This is the raw material from which crooks stamp out illegal, dime-size slugs for use in coin telephones and vending machines. Also to be looked out for, according to the Copper and Brass Research Association, is the material for nickel slugs, an alloy containing 18 percent nickel, 18 percent zinc, and 64 percent copper, in strips two inches wide and 51, 1,000 of an inch thick.

ACCORDING TO THE National Tool Builders Association, the total number of machines built in the United States during the last year has shot up from the normal 25,000 to 100,000. By the end of this year the figure is expected to approach the 200,000 mark. It is estimated that the new machines are, on the average, three times as productive as machines of older designs. Nearly all the new production is going to Great Britain, Russia, and the United States.

THE NEXT TIME you have a tooth pulled, the dentist will probably give you a shot in the arm instead of putting a mask over your face and telling you to count. With an injection of pentothal sodium, a dental patient will react to instructions but have no memory of anything that happens until the offending tooth is out. The recovery period is from 10 to 15 minutes and the drug is said to have no ill effects. The results have been so satisfactory that pentothal sodium is now being used in 90 percent of the cases in which nitrous oxide (so-called laughing gas) was previously used.

America Can't Wait
Industry needs you NOW

Defense Program Needs Trained Men

There is a tremendous shortage of skilled men in almost all branches of industry. Draftsmen, electricians, machine designers, machinists, are wanted for good jobs at fine pay. Executives too, foremen, superintendents, managers, are needed right now to handle the enormous demand for finished products of all kinds. If you are already in one of these fields, you owe it to your country, to your family, and to yourself to make yourself even more valuable, to climb and climb fast and help put through the most important program we have ever had to face.

Opportunities Everywhere

Home building, ship building, manufacturing plants, great utility projects, road building—everywhere you look you find a demand for men—not just ordinary workers, but men who know more than their fellows, who are better at their jobs, who know both theory and practice and can therefore train other men, thus rising to more and more important stations and being of greater and greater help. Practically every industry is included in those needing MEN, trained men, skilled men, men with ambition and punch.

Rich Rewards

In bidding for skilled men now industry of all kinds, everywhere in the United States is offering big pay. They want the best men and they are willing to pay for their services. But remember this, you not only have opportunity for bigger pay—can you probably ever hope for—but the chances for advancement are even greater. Foremen, superintendents, factory managers, must be drawn from the ranks, and surely you know that the man who studies, who tries to know everything there is to know about his job will be picked first. Best of all, under the present training program, with the tremendous demand for skilled men you don't have to look too far in the future for

Results Come Quickly

Learn at Home

Over 40 years ago we developed a system of home study which has helped thousands of men to important positions in the mechanical and business world. Those of you who have missed college training, who haven't the time to go away to school, who must LEARN AS THEY EARN, can get education in your particular field—yes, education of college grade right in your own home. Best of all, you can study when you have the time, and above everything else you will have the commendation and the respect of your employers in doing so. Rest assured that every superintendent, every factory manager, every general manager will have his eye on the man who pushes forward, who recognizes the great need of the day, and who has made up his mind to be one of the first to make good.

Get the Facts

(No Cost) All you have to do to find out about this type of training to get the details and the quality of study which is one of the successes of other men, is to write us or send the coupon. There is no cost and no obligation of any kind. Let this great school one of the pioneers in the home study field, explain the methods which can do so much for you. Get this information now so that you can make up your mind to lay by to get started on the road to the fulfillment of a great ambition, and so that you may be of the greatest possible help in this present emergency.

Business Welcomes Applications from American School Advanced Students and Graduates

Whenever trained men have been badly needed, business has been quick to say, "We welcome applications from American School advanced students and graduates." We maintain an employment placement service to help put you in touch with the best openings, and we make no extra charge of any kind for this service. Write now for an outline of home study training courses; check the coupon indicating your preference and mail it promptly.

AMERICAN SCHOOL
Dept. G146, Drexel at 58th, Chicago

Mark, Clip and Mail This Coupon NOW!

AMERICAN SCHOOL, Dept. G146, Drexel at 58th, Chicago

Without obligation. Please send FREE and postpaid, bulletin and details of the Subjects checked.

- ☐ Air Conditioning
- ☐ Elec. & Gas Refrigeration
- ☐ Architecture and Building
- ☐ Plumbing and Steam Fitting
- ☐ Automotive Engineering
- ☐ Aviation Drafting
- ☐ Aviation Engineering
- ☐ Business Management
- ☐ Accounting and C.P.A.
- ☐ Salesmanship
- ☐ Retail Merchandising
- ☐ Cost Accounting
- ☐ Practical Bookkeeping
- ☐ Economics of Direct Selling
- ☐ Private Secretary
- ☐ Diesel Engineering
- ☐ Surveying & Topographical Drafting
- ☐ Sheet Metal Pattern Drafting
- ☐ Electrical Engineering
- ☐ Drafting and Design
- ☐ Radio and Television
- ☐ High School
- ☐ Home Economics Courses
- ☐ Business Law
- ☐ Liberal Arts
- ☐ Mechanical Engineering
- ☐ Shop Management
- ☐ Tool Making
- ☐ Better Foremanship
- ☐ Engine and Boiler Work

Name..... *Occupation*.....

Address..... *Age*.....

City..... *State*.....

Readers Say:

We're as Full of Christmas Ideas As Santa Claus's Workshop

I've READ your magazine for about two years now, and this is the first time I've written to you. I might add, it's the first time I've ever written to a magazine editor. I think your magazine is the best on the market, and I wish to compliment you on it. I have a few ideas, however, on its contents. First, I think you should have a page telling readers where they can get the articles described in the magazine. Second, I think you should have more ideas for Christmas presents which can be made in a shop not too well equipped, appearing in your November, December, and January issues.—T. L., St. Joseph, Mich.

If T. L. will look carefully in the issues he names, he ought to find enough Christmas ideas to keep him busy.—Ed

About Those Old Alarm Clocks —Why Not Fix Them Up?

THE REQUEST of E. J., of Brooklyn, N. Y., in the October issue of P. S. M., regarding old alarm clocks aroused my interest. I would suggest *repairing* the old clocks. Fully three fourths of the old alarm clocks are laid aside before their useful life is ended, simply because they are so cheaply made that it does not pay for jewelers to repair them, since the owner can get another for the price of a decent repair bill. However, the average mechanically minded fellow who can follow through the workings of a radio could master an alarm clock too, and could add a year or two to its useful life. All it takes is a few tools, a little benzine, a steady hand, a few drops of oil, and a lot of patience. —B. H. B., Bronte, Tex.

The Key to This Problem Has a Different Twist

HERE is a problem for those who like tricky puzzles that don't involve differential calculus or any reasonably accurate facsimile: Once upon a time there were a clock, a pendulum, and a key. Each time the key was turned one complete revolution, the hour hand moved 17 minute spaces on the dial; each time the minute hand moved one minute space, the pendulum made 30 complete vibrations. If the key were turned 13 complete turns, how many single vibrations would the pendulum make before it came to a complete stop? The correct answer will be found on page 119 in the August 1941 P. S. M., by subtracting 64 from the number in the very top line of that page.—J. C. A., Los Angeles, Calif

And What Can You Make from Veneer Trimmings?

IS THERE a craftsman in the house? Okay, then maybe some of those knothole inventors can tell me if anything can be made from veneer trimmings up to four inches wide, five feet long, and 1/16 inch thick, of such woods as maple, mahogany, walnut, oak, etc. I have lots of this kind of material which could be made into salable articles if only I had a few suggestions.—E. B. R., Woodlawn, Va.

There's Gold in That Attic —on Old Picture Frames

HERE is a question I would like some reader to answer Is there any way to remove the gold from old picture frames? And how can you tell the difference between gold leaf and gold metallic paint? - W. J. G., Chicago, Ill.

Somebody tell W. J. G. how to mine that vein of attic gold.— Ed.

SPECIAL TRAINING with a Personal Educational Service is offered to you by the INTERNATIONAL CORRESPONDENCE SCHOOLS OF SCRANTON, PENNSYLVANIA

TECHNICAL COURSES

Air Conditioning Schools
Air Conditioning
Heating
Plumbing
Refrigeration
Steam Fitter

Chemistry Schools
Chemistry, Analytical
Chemical Engineering
Chemistry, Mfg. Iron and Steel
Mfg. of Pulp and Paper
Pharmacy

Civil, Architectural and Structural Engineering Schools
Architecture
Architectural Drafting
Bridge and Building Foreman
Bridge Engineering
Building Estimating
Civil Engineering
Concrete Engineering
Contracting and Building
Highway Engineering
Retail Lumberman
Structural Drafting
Structural Engineering
Surveying and Mapping

Electrical Schools
Electrical Engineering
Electric Wiring
Gas and Electric Welding
Industrial Electrician
Lighting Technician
Power House
Practical Telephony
Radio, General
Radio Operating
Radio Servicing
Telegraph Engineering

Internal Combustion Engines Schools
Automobile Technician
Aviation
Diesel—Electric
Diesel Engines
Gas Engines

Mechanical Schools
Airplane Drafting
Foundry Work
Heat Treatment of Metals
Inventing and Patenting
Machine Shop Practice
Mechanical Drafting
Mechanical Engineering
Metal Pattern Drafting
Mold Loft Work
Reading Shop Blueprints
Sheet Metal Worker
Ship Drafting
Ship Fitting
Shop Practice
Steel Mill Workers
Tool Designing
Wood Pattern Making

Railroad Courses
Air Brake
Car Inspector
Locomotive Engineer
Locomotive Fireman
Railroad Car Repairer
Railroad Section Foreman

Steam Engineering Schools
Boiler Making
Combustion Engineering
Engine Running
Marine Engines
Petroleum Refining Plant
Steam Electric
Steam Engines

Textile Schools
Cotton Manufacturing
Textile Designing
Woolen Manufacturing

BUSINESS and ACADEMIC COURSES

Academic Schools
Arithmetic
College Preparatory
First Year College
High School
Higher Mathematics
Illustrating

Business Schools
Accounting
Advertising
Bookkeeping
Business Correspondence
Business Management
Certified Public Accounting
Commercial
Cost Accounting
Foremanship
Salesmanship
Secretarial
Stenography
Traffic Management

Civil Service Schools
City Letter Carrier
Post Office Clerk
Railway Postal Clerk

Language Schools
French
Good English
Spanish

If you can read and write, and are willing to study,

WE CAN TEACH YOU!

Our aim is to explain everything so clearly that the subject is made easy to understand, easy to remember, and the principles are easy to apply.

• *Special service and attention are always given to the student who may need extra help in order to understand.*

REASONABLE TERMS MAY BE ARRANGED

The successful man DOES today what the failure INTENDS to do tomorrow. Mail this coupon NOW!

International Correspondence Schools
Box 7624-K, Scranton, Pa.

Please send complete information on following subject:

_____
(Write above Technical, Business or General Educational Subject in which you are interested.)

Name _____ *Age* _____

Address _____

Employed by _____ _____

Present Position _____

Readers Say:

It's a Fine Way to Lose Friends and Electrocute People

MY ONLY complaint with P.S.M. is that you don't make it a weekly or daily magazine, for every time an issue arrives I read right through the thing and then have to sit and wait for the next one. I don't like articles on radio, because my brother is an ardent radio fan and there are old radios, amplifiers, tubes, speakers, resistors, and condensers lying all over the house and basement. One night we were testing the circuits of an old radio with a small condenser and in the midst of the testing some of our friends walked in. As they came in the door, my brother loaded the condenser and yelled to one of the visitors, "Here, Bud, catch!" Well, he caught it in more ways than one. After dragging our visitor back into the house, we greeted him very cordially. He's a broad-minded fellow and readily takes a joke. I think this would be a good method for housewives to get rid of persistent salesmen. What do you think? —E. S., Chicago, Ill.

He's Keenly Interested in Cutting Edges

NOT LONG ago, some reader inquired how to sharpen a straight razor. "Silly question," another reader replied. "Ask your barber." But how many barbers know the how, when, and why of a really sharp razor—and can explain it to a layman? Cutting edges in general are mighty important in all industries. How are they produced commercially by mass-production methods—safety-razor blades, for instance? Is a cutting edge a single line of molecules? An interesting and practical subject for a scientific article by an able writer. How about it, Mr. Editor?—W. C. C., Delaware, Ohio.

Readers Say:

O.K., F. P., You Asked for It —But Don't Expect Answers

TODAY I got out my thinking cap, polished it up, and had to hunt through two years of Pop Science to find a good problem. What's the matter? My sister had a file of old (vintage '33 to '36) P. S. M.'s and there wasn't a magazine that didn't have a problem in it, or at least an argument. We want more brain-teasers! That's the only thing this almost-perfect magazine needs. I remember especially, y'ars and y'ars ago, an argument between three R. H.'s of various towns, about Darwin and his theory. This raged hot and heavy for about six months, after which it was stopped. There was another argument about bees and drones that was interesting, but I looked through two years from this date without finding a good argument or problem. Something's wrong! Problems are hard, and I, for one, want more and more!—F P., Bradford, Pa.

P. S. M. Takes to the Field for Latest Defense News

IN ACTION in recent U. S. Army maneuvers were some of the latest weapons and plans for national defense. And observing them for Popular Science readers were Charles McLendon, editor; William Morris, photographer; and Hickman Powell, writer. Among the stories they got for this issue are "Grasshoppers," "Sensitive Microphones Spot Hidden Guns," "Trucks and Trailers," "Americans Take to Tanks."

NOT EVERYONE DOES AS WELL *but*—$148 First Week GROSS IN HIS OWN BUSINESS

is what L. A. Rowe reports. We want reputable, honest men. You need no special experience but you must be industrious and courteous. We will help you get into a high-grade business of your own where you will be your own boss. No shop necessary. Rug Washer cleans rugs beautifully on customer's floor. Machine is very simple. Electricity does the work. Simply clean a few rugs. These customers tell others and give you their future work. There are hundreds of prospective customers in your vicinity and nearby towns. Send coupon for booklet explaining everything.

WHAT OTHERS HAVE DONE

The following instances of maximum gross earnings, for stated periods, by exceptional operators, are an indication of what can be done by a live-wire in his busiest seasons. These earnings do not reflect continuous operations and of course are not net. In addition to any other expenses a small amount should be allowed for depreciation and supplies.

$148 first week. Had no job; now in own business doing fine—L. A. Rowe. Have had weeks close to $400; sure glad I got machine—L. T. Jordan. Last month I took in $779.81; my best day was $57.48—G. E. Carpenter. Have had machine 3 months; 1st month $25, next 2 about $400—M. Gorski. My biggest month was $500 to $600 but can t do it every month—W F Baron. Past 6 weeks worked about 5 hours daily and did $320—M. E. Pullen. Made $150 in 2 days; going to Florida today on $200 job—G. Sears. $54.50 best day; had machine 3 years, am 71 years old—J. W. Benson. $192 50 in 14½ days; have had machine 4 weeks—A. G. Bassinger. $203 78 in 30 hours. Your method "Hit the spot" here—C. Lever. $42 50 in 3 hours. Am very well pleased with machine—O. C Dahl. Took in $1,100 in 18 days; now have 3 machines—E. C. Thomas.

"NEVER A COMPLAINT" A. C. Canfield writes, "We have all the business we can handle—and not yet one complaint." That's the nicest part of this business—customers are more than satisfied.

Every Machine Guaranteed These machines have been manufactured since 1914 and are used by many successful operators throughout the world. They are GUARANTEED.

EASY TERMS The complete equipment is inexpensive. A reasonable down payment brings everything to you and the balance is paid monthly. From the start you have your own business—one that is profitable and of which you can be proud.

VON SCHRADER MFG. CO., 361 Pl., Racine, Wis.

FREE BOOK—Mail Coupon NOW!

VON SCHRADER MFG. CO., 361 Pl., Racine, Wis.

Send at once (no obligation) your free booklet illustrating rug washer and telling how I can own my own permanent business, how I can earn large profits at prices below other methods, how I can become financially independent in a short time, and how I can pay on easy terms.

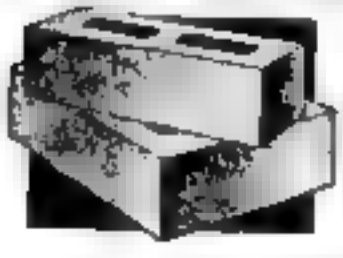
Name.....

Address.....

City..... State.....

Gear YOUR Business to ESSENTIAL WORK

Priorities, shortages and increasing costs are forcing adjustments in every line of work and business. Particularly in the building industry, where lumber and steel are hard to get, even at soaring prices.



You can capitalize on these conditions by supplying the trade with Brikcrete—the new scientific masonry unit. Better than brick, yet brings wall costs down to frame prices. Fireproof, termite-proof, permanent. Has beauty of color and streamlining strength and self-contained insulation.

No Priorities • No Scarcities

Brikcrete is made from materials and labor that will always be plentiful and low priced. Unlimited market possibilities now and in the future. We supply complete plant equipment for local manufacturing in protected territories. Requires but modest investment. Profits up to 150%. Write immediately for The Brikcrete Book—free.

BRIKCRETE ASSOCIATES, INC.
4475 Division Avenue, S.,
Grand Rapids, Michigan

BRIKCRETE

BRUSH PLATING OUTFITS

• for autoparts, reflectors, faucets, bicycles. No tanks necessary. Free particulars. •

GUNMETAL CO., AVE. F, DECATUR, ILLINOIS

STUDY AT HOME

With A Chartered Educational Institution
Conducted by Correspondence

Courses in Arts, Sciences, Philosophy, Education, Public Health, Medical Jurisprudence, Psychology, Nursing, Physics, Chemistry, Geology, Pol. Science, Theology, Law, Business Training, Accounting, Statistics, Agriculture, Wireless, Electrics, Civil, Mechanical, Drafting, Architectural, Automotive, Steam, Diesel, Aeronautical, Radio, Structural, Industrial Engineering, Petroleum Mining, Marine, Refrigeration, Air Conditioning, Chemical.
McKinley-Roosevelt Incorporated, 4410-AC Sheridan Road, Chicago

When Writing Advertisers
Please Mention POPULAR SCIENCE

TYPEWRITER 1/3 PRICE

STANDARD OFFICE MODELS
About ⅓ MFRS. ORIG. PRICE
As Low As **70¢ A WEEK**
All models completely rebuilt like brand new.
FULL 3-YEAR GUARANTEE
No Money Down—10 Day Trial
FREE COURSE IN TYPING INCLUDED
Send for FREE price list and easy payment plan. Fully describes and illustrates all models. See our literature before you buy. SEND TODAY.
INTERNATIONAL TYPEWRITER EXCH.
Dept. 107 231 W. Monroe St., Chicago, Ill.

10¢ A DAY

EASIEST to MASTER

A NEW BUESCHER True-Tone

JUST OUT—new—radically improved Buescher Saxophone that enables you to master tunes easier than ever; qualify for band in a very short time. Then popularity plus friends; good times; and extra money. NO instrument equals Buescher for quick results. FREE Home Trial, easy payments, any instrument, sax, trumpet, trombone. Write today.

FREE Beautiful 32 Page Magazine or Book. Send Card—Mention Instrument That Interests You

BUESCHER BAND INSTRUMENT CO.
Dept. 110 - - - ELKHART, INDIANA

ELECTRICAL TECHNICIANS

Urgently Needed!

Special class begins Feb. 10—finishes in Dec.
Saves you valuable months! Regular Bliss course that has prepared 8,000 men for better jobs in the electrical field. Bliss graduates hold excellent positions as technicians, engineers. Similar opportunities await you! Send for catalog today.
101 Takoma Ave., Washington, D. C.

BLISS ELECTRICAL SCHOOL

AN AVIATION CAREER

OFFERS YOU GREAT FUTURE!

Demand for trained aircraftsmen is increasing and already exceeds supply. Curtiss-Wright Tech, Aviation's foremost school, is located on Grand Central Air Terminal in heart of the aircraft industry and specializes in training MASTER MECHANICS and AERONAUTICAL ENGINEERS. (No flying involved.) Graduates are obtaining immediate employment. Write for details NOW. Dept PS-1

Curtiss-Wright Technical Institute, Glendale (Los Angeles) California

42nd YEAR ENGINEERING DEFENSE COURSES

Short, Intensive Defense courses in Aircraft, Sheet Metal, Mechanical, Structural, Architectural Drafting, Electricity, Power Plant, Arc, Aircraft Welding. One and Two-Year courses in Aeronautical, Electrical, Mechanical, Structural, Architectural, Civil Engineering. B.S. Degree 3 Yrs. Low tuition and living costs. Part-time work for room and board. Thousands successful graduates. Extensive equipment. Theory and practice. Non-essentials omitted. No home study courses. Catalog free.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

RADIO LESSON FREE

"INTRODUCTION TO RADIO"

SUPREME PUBLICATIONS, 328 S. JEFFERSON ST., CHICAGO, ILL.

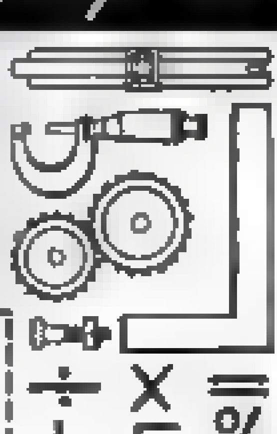
Get into the BAKING BUSINESS

Bakers make good money! Now 7th Industry in wages! Nearly depression proof. New home study Baking Course qualifies you. Common school education sufficient. If you're ambitious, write for FREE BOOK, "Opportunities in Baking."
National Baking Institute, 1315 Michigan, Dept. 1361, Chicago

Short-Cut Mathematics

COMBINED WITH

Practical Mechanics Simplified



NEW 2 in 1 reading course! Now you can learn the speedy, simplified system of calculation used by draftsmen, engineers, accountants, "master minds" on the stage. Learn easy way to multiply 4 figures by 4 figures without using old fashioned multiplication; add long columns of figures this lightning short-cut method. Learn horsepower, slide rule, micrometer, logarithms, wood measure, puzzles, etc., etc. Large illustrated volume complete with answers, only $1 postpaid. Satisfaction or refund.

FREE Amaze friends with your magic-like mental powers. Complete details . . . mail coupon TODAY!

NELSON CO., 500 Sherman St., Dept. [illegible] 204, Chicago
Please send free details about "Short-Cut Mathematics and Practical Mechanics Simplified." No obligation.

Name________________________

Address________________________

DON'T FORGET THIS: A little idea may have big money-making possibilities!

PATENT and SELL your INVENTION

Act now!
U. S. Patent Laws favor the first to act. Delay may be costly. Write us today.

BUSINESS today is eager for practical, new manufacturing ideas. Opportunity for men with inventive talent was never greater than it is right now. If you have an idea for a new device—no matter how simple it may be—or for the improvement of an article now in use, find out AT ONCE how you can protect your rights to it and proceed to commercialize it. These two advisory books offered you without cost, may prove invaluable to you. Send for them NOW.

68 PAGES OF FACTS FOR INVENTORS

44 years of helpful service to inventors

Plainly written, easily understood. Tell you how to apply for patent protection, give six basic methods of selling your invention. Get them TODAY.

VICTOR J. EVANS & Co.

Merlin M. Evans

REGISTERED PATENT ATTORNEYS
MAIN OFFICE: 529-A VICTOR BUILDING
WASHINGTON, D. C.
Pittsburgh Office: 521-C Empire Building
Los Angeles Office: 728-C Security Building

Send me free copies of your books "Patent Protection" and "When and How to Sell an Invention"—also important "Evidence of Invention" form.

Name . . . .

Street and No. . . . .

City or Town . . . . State . . . .

INVENTORS
PATENT YOUR IDEAS
SEND FOR FREE BOOK

HOW TO OBTAIN A PATENT

Written by a Former Member of the Examining Corps (1912-24) of the U. S. Patent Office. If you want to profit by your idea, you should take steps to apply for a U. S. Patent at once. Your first step is to get this Free Book. This interesting illustrated book contains valuable information you should have. It tells you fully how to obtain a patent on your idea in the quickest way. With this Free Book you will also receive a "Record of Invention" form on which you can easily record your idea. Personal and Confidential Service. Your case will be personally handled only by a Registered Patent Attorney who is also a Former Member of the Examining Corps of the U. S. Patent Office. All communications confidential.

MAIL COUPON TODAY for FREE PATENT BOOK and RECORD OF INVENTION Form

CARL MILLER
REGISTERED PATENT ATTORNEY
FORMER MEMBER EXAMINING CORPS U. S. PATENT OFFICE

Woolworth Bldg., 15th Floor, Dept. 12-C, New York City
MILLER BUILDING, Dept. 12-C, WASHINGTON, D. C.

Please send me your Free Book, "How to Obtain a Patent," and your "Record of Invention" form.

NAME .....

ADDRESS .....

PATENTS
PERSONAL SERVICE

My Personal service assures strictest confidence on all your patent problems. Send me a model or drawing, or sketch and description of your invention, and $5.00. I will make a search and report promptly as to its patentability and send you a copy of my 72 page booklet. Or, if you prefer to read my booklet first, write today for FREE copy. Registered Patent Attorney.

L. F. Randolph, 340-D Victor Bldg., Washington, D.C.

DRAFTSMEN NEEDED *Now*

Industry is clamoring for more draftsmen, for the job can't start until plans are drawn. Buildings, airplanes, machines, guns, tanks, bridges, all start on the drafting board, so it's no wonder that every good draftsman has a fine job. Yes, more draftsmen are needed NOW. The pay is good and the opportunities for advancement great.

Learn at Home in Spare Time

Begin now to turn spare hours into money. Be a draftsman, the connecting link between a mechanic and an engineer. Enjoy the wonderful opportunities for promotion that exist now. No experience or artistic talent is needed. You don't have to leave your present job while learning. Use spare time.

Employment Service Included

Students who take our home study drafting course are entitled to our employment service without extra charge. We are in constant touch with many great firms needing men, and in times like these industry welcomes applications from American School advanced students and graduates.

The total tuition cost is low and the monthly payments are easy. Write today for free bulletin outlining our instruction and giving you the details of our selective employment service. No obligation of any kind. Write [redacted].

AMERICAN SCHOOL
Drexel Avenue at 58th St. Dept. DD148 Chicago

Big Pay in AVIATION

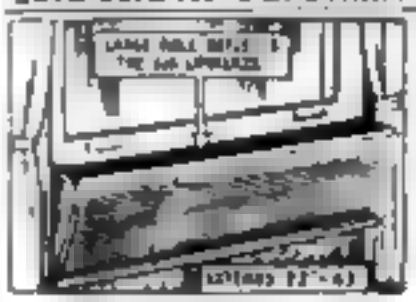
Earn $50, $75, $100 a week in Aviation! Wonderful opportunities now! This Lincoln [redacted] wants to immediately get in touch with men interested in preparing now for positions as **Professional Pilot, as Flight Instructor, as Airline Mechanic, as Airplane Factory Mechanic or Airplane Inspector.** We train you and assist Graduates in locating positions. Now offering Board and Room in exchange for after-school employment. **WRITE TODAY for complete information.**

LINCOLN AIRPLANE & FLYING SCHOOL
641 Aircraft Building, Lincoln, Nebraska

KINKADE GARDEN TRACTOR
and Power Lawnmower

A Practical Power Plow and Cultivator for Gardeners, Suburbanites, Florists, Truckers, Nurserymen, Fruit Growers

Low Prices - Easy Terms
American Farm Machine Co. Catalog Free
1072 33rd Av. SE. Minneapolis, Minn.



WAR ON COLDS!

Do not sleep in a draft. Many serious colds result from sleeping in a draft. Protection is necessary—Draft Health Guard Window Ventilator deflects draft upward. Fits windows up to 43 inches, prevents rain and snow damage, catches dust, affords privacy. Not breakable.

DISTRIBUTORS WANTED

Reg. Price $2.95 — Special Price $1.65 — We pay shipping cost.

Draft Health Guard Co., 154 E. Erie St., Chicago, Ill.

LEGS — ARMS — BRACES

The best money can buy—our 133 employees wear 176 appliances. Write us your needs.

Hale Artificial Limb Co. 400 5th Ave. S. Minneapolis, Minn.

SECRET SERVICE BOOK FREE

Sent for 30 Days Reading

No Money Down—Actual Crime Cases—If You Act Quick. We will send you this startling book on Crime Detection, Secret Service and Identification Work for 30 days free reading. Send no money. If you decide to keep it, then send me only $1.98. If not, return it. WRITE TODAY. Literature sent only to persons stating their age.

T. G. COOKE, Dept. 1361, 1920 Sunnyside Ave., Chicago

YOUR OWN BUSINESS
MAKING CASTINGS FOR US

We need additional full or spare time manufacturers to cast for us Christmas Goods 5 and 10c Novelties, Ashtrays, Toy Autos, Soldiers, etc. Can be started in any spare room and no experience necessary. An opportunity to be your own boss and make real money. For full information about this interesting and profitable work write

METAL CAST PRODUCTS CO. Dept. E.
1696 Boston Road New York, N. Y.

MEN WANTED!
EARN MONEY EASY WITH GREAT NEW TAILORING LINE
SENSATIONAL PAYMENT PLAN

Unbeatable values! Order-getting features galore—make it easy to earn big money and get your own suits FREE as extra bonus, show my friends sensational new line made-to-measure suits and taking orders on partial payment plan. No experience. No money needed to cash in big! Write at once for complete actual sample line of rich new woolens, newest styles and sure-fire-order-getting plans. Send!

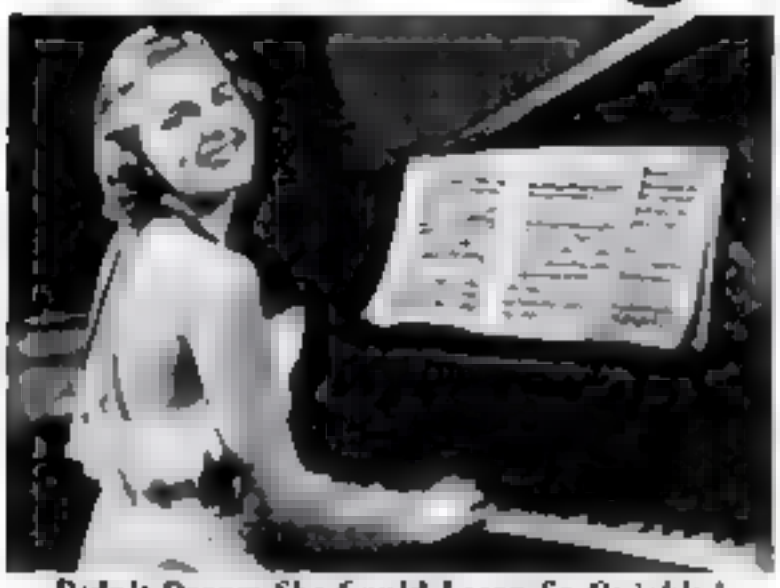
GIBSON 500 South Throop St., Dept. A821 Chicago, Ill.

MAKE MONEY AT HOME

RUBBER MOLDS *Low as* 6¢ ea.

Amazing rubber mold-making outfit makes perfect flexible molds of plaques, ash trays, book-ends etc. Molds cost from 5c to 25c each. Each mold makes hundreds of novelties and gifts to sell up to $1.00 apiece! No experience necessary. Quick and easy. Start profitable business in your home . . . sell to stores, gift shops, friends, resorts, road stands, by mail. Full or spare time. "Molders Ready Book" and list of secrets FREE. Write

SO-LO WORKS
Dept. L-823 Cincinnati, Ohio

Please mention POPULAR SCIENCE *when writing to advertisers.*

When Writing Advertisers
Please Mention POPULAR SCIENCE

Do you want

→ ..to go to College?

→ ..or to enter a Profession?

(Such as Accounting, Architecture, Nursing, Dentistry, Teaching, Social Work, Chiropathy, Beauty Culture, Optometry, Embalming, Chiropody, Law, Medicine, etc.)

→ ..or get an Office Position?

To get anywhere, you practically MUST finish High School FIRST. You can complete our simplified High School Course in SPARE time at home, as FAST as your time and abilities permit. Equivalent to resident school work—prepares you for college, pre-professional examinations, business, industry. Standard texts furnished. Diploma. Credit for H.S. subjects already completed. Single subjects if desired. Low tuition, easy terms. American School, Chicago, est. 1897, endorsed by educators. Finish your high school education NOW. Write TODAY!

High School Course at Home

Many Finish in 2 Years

American School, Dept. H-146, Drexel Ave. at 58th St., Chicago, Ill.

Gentlemen: Send me FREE information covering special training in subjects checked below. No obligation on my part.

- ☐ High School Course
- ☐ Accounting and Auditing
- ☐ Architecture and Building
- ☐ Automotive Engineering
- ☐ Business Management
- ☐ Aviation
- ☐ Electrical Engineering
- ☐ Elec. and Gas Refrigeration
- ☐ Air Conditioning
- ☐ Diesel Engineering
- ☐ Drafting and Design
- ☐ Liberal Arts
- ☐ Private Secretary
- ☐ Mechanical Engineering
- ☐ Radio and Television
- ☐ Salesmanship
- ☐ Business Law
- ☐ Retail Merchandising

Name .....

Address .....

AMAZING CHEAP OIL BURNER

Sweeping the Country!!

COOK and HEAT Without Coal or Wood

In Your Present Stove or Furnace—

—No Drudgery, Dirt or Ashes—Heat at SMALL COST.

OVER 40,000 SOLD

Beats any cheap burner ever gotten out for low cost, efficient performance. Burns low priced free flowing oil. No small openings to clog. Heat Regulated by Turn of Valve—as much or as little as you want. A Guarantee with each burner.

30 DAYS' TRIAL

Prove its efficiency, convenience and economical operation.

Write Immediately for SPECIAL OFFER TO AGENTS

AGENTS Salesmen BIG MONEY

F. Silver says: "I can dispose of 200 HEAT KINGS before this year ends." Write us now for agents offer.

HEAT regulated by Turn of Valve!

who will demonstrate and take orders. Write quick, be first to learn how to make REAL MONEY right now, spare or full time. Mail postcard today.

UNITED FACTORIES, A-761, Factory Bldg., Kansas City, Mo.

ARTISTS MAKE MONEY

Find out your ability. Send name, age, occupation and address for Free Vocational Art Test.

ART INSTRUCTION, INC., 1142 Art Instruction Bldg., Minneapolis, Minn.

(Formerly Federal Schools, Inc.)

Correspondence Courses in RADIO and ELECTRICAL ENGINEERING

LOW AS $25

ELECTRICAL ENGINEERING. Get good grasp of wide electrical field. Modern. Very understandable. Theory made easy.

RADIO ENGINEERING. Extra fine course in radio, public address, photo-electric work. Trains you to be expert service man, real vacuum tube technician. Tuition ONLY $25, other courses. Deferred payment plan. Experiment kits furnished.

FREE Write for free copies of school catalogs, student magazines, etc.

LINCOLN ENGINEERING SCHOOL, Box 931 B37, Lincoln, Neb.

IS REPORTED BY E. C. TRAPOR. He uses newly invented machine which washes walls 6 times faster, and better than by hand. Here are more high earnings reported by men in their busy seasons. Of course they do not reflect earnings every day or every week, and a small amount must be deducted for materials, but they show what can be done by good men during their busy seasons.

Have $1,870 worth of work lined up for next two months—Harry Tyler
Machine arrived today. Have $40 job tomorrow—H. Fredericks
Got $905 school building job. This is a repeat order—C. Irons
First two jobs netted me $26. Good beginning—L. Nash
Just getting started. Did $50 job in 2½ days—N. Heath
Paid for machine with work I did the past week—J. Howe
$25 for ½ day's work. Start on hotel tomorrow—J. A. Grinder

Customers everywhere. Homes, schools, offices, stores, churches, lodge halls, hotels—all have walls that need washing.

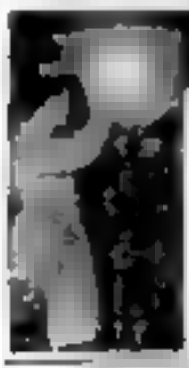
EASY PAYMENTS

It takes only a few dollars to get started in this money-making profession. No experience necessary. The total price is so small and the payments so easy that anyone with ambition should get started now.

Send for Free Information—There is No Obligation.

VON SCHRADER MFG. CO.
781 Pl., Racine, Wis.

LEARN WELDING



Both Electric Arc and Acetylene by practical Shop-Plan method in a few short weeks. No text-books. You learn by doing. Finest equipment. Low tuition. Pay After-Graduation-Plan. Also, courses in Auto Mechanics, Collision Work, Metal Finishing, etc. Illustrated literature free. Write today.

MICHIGAN TRADE SCHOOL
3719 Woodward, Detroit, Mich.

FREE 32 PAGE CATALOG

5¢ EACH LITTLE BLUE BOOKS

Send postcard for our free catalogue. Thousands of bargains. Address HALDEMAN-JULIUS CO., Catalogue Dept., Desk M-806, GIRARD, KANSAS.

IF I Send YOU THIS FINE SUIT—

Will You Wear It and Show It to Friends?

I need a reliable man in your town to wear a fine made-to-measure, all-wool DEMONSTRATING SUIT advertising my famous Union clothing—and take orders. You can make up to $12.00 in a day. My line contains over 150 quality woolens, all sensational values, guaranteed.

CASH IN ON PARTIAL PAYMENT PLAN

You need no experience or money. I supply everything required FREE. Write me today for FREE details.

STONEFIELD, 1300 W. Harrison, Dept. A-820, Chicago

See the WOODSTOCK TYPEWRITER

Army Cadets of-the-Air

ALL the stages . . . from grease monkeying to Al piloting . . . from sunny take-offs to mud bath landings . . . flash to life in Popular Science on-the-Screen's story of Randolph Field . . . West Point of-the-Air.

Ground pups have a sky-high ambition to be air dogs to perfect America's defense. In a thrilling world of roaring propellers these young experts-in-training make a FULL COLOR MOVIE packed with action, thrills, drama . . . birdmen of tomorrow doing their stuff.

Popular Science on-the-Screen

Produced in Magnacolor by Fairbanks and Carlisle with the cooperation of the editors of Popular Science Monthly Distributed by Paramount Pictures

If This and Regular Issues of Popular Science on-the-Screen are not scheduled at your favorite Theatre, mail the coupon.

Theatre_____

Address_____ 142

Mail to: Popular Science on-the-Screen
353 Fourth Avenue, New York, N. Y.

FREE BOOK TELLS HOW YOU CAN LEARN TO MOUNT BIRDS and ANIMALS

BE A TAXIDERMIST—Learn by Mail

Easy home lessons teach you quickly how to MOUNT BIRDS, ANIMALS, GAME HEADS, FISH—to TAN LEATHER, FURS. Save your hunting trophies. Have a home museum. It's thrilling! Taxidermy is wonderful FUN, A PLEASURE HOBBY AND A MONEY MAKER.—Investigate! Get this strange FREE BOOK.

EXTRA MONEY: —Earn in your spare time. Sell your mounted and do work for other sportsmen. Students report $30 to $75 and more per month. Big demand. Fine prices. If you want REAL PROFIT from spare time WRITE TODAY.

Game is growing scarce—every specimen valuable!

FREE BOOK —with 100 photos of wild game. Tells about Taxidermy and how YOU can learn easily, quickly. Old reliable school. 275,000 students. — — STOP this minute and **TEAR OUT THIS AD NOW** as a reminder; then write, get the free book. You will be delighted, AMAZED. RUSH postal or letter and learn how to have more FUN, FASCINATION, PROFIT. State your AGE.

Northwestern School of Taxidermy, Dept. 3391, Omaha, Neb.

•Inventors

Free Books Answer Questions— Tell How to Get Protection

• Your ideas may be worth money! Get *facts first* and save time and money. Competent advice on patent procedure is essential to good results. Our 67 years' experience enables us to explain everything you need to know about protecting and commercializing your idea. Prompt, confidential service and results. *Mail coupon today for free patent booklets and Special "Certification of Invention" form (covers first important step).*

MAIL COUPON For Your FREE BOOKS Explaining:

How to obtain a patent . .

Why you need a patent . . .

Correct way to proceed and costs.

How you can commercialize your patent . . .

C. A. SNOW & CO.
Registered Patent Attorneys Since 1875
221 SNOW BLDG., WASH., D.C.

Please send me the free books and form mentioned without cost or obligation.

NAME . . . . . .

ADDRESS . . . . . .

OPPORTUNITY TO EARN $1040 WHILE LEARNING

Available to Students Through Cooperation of Milwaukee Industries

A most unusual offer to qualified men who must earn tuition and part of living expenses while preparing for career as Aircraft Technician, Draftsman, Electro Technician or Welding Technician. Choose any of these four up-to-the-minute practical courses and train for work in vital defense industries. A few more "In Service" fellowships offered by cooperating Milwaukee manufacturers still available. 3-months courses in Aircraft or Arc Welding also offered. Write now for full details and your copy of "Career Building" without obligation. Mention course desired.

MILWAUKEE SCHOOL of ENGINEERING
PS-142 N. Broadway & E. State — Milwaukee, Wis.

Radio BEGINNER'S Simplified Manual

Every radio operation from simple soldering to trouble shooting, to building and improving marvelous long and short wave sets, is made so simple and clear that you just cannot fail to understand many things that may have puzzled you before. A few minutes a day with this manual will teach you what it takes years to learn without it. Prepared by technical radio experts who KNOW how to explain things for non-technical radio enthusiasts.

How To Test, Build, and Service RADIO SETS

Simple tools needed, soldering simplified, chassis making, voltage, amperage, etc explained, checking circuits, measurements, formulas, definitions, testing condensers, transformers, coils, speakers, polarity, ground, etc. Radio kinks and short cuts, space-winding coils, making plug-in coil forms; wiring hints; experimental binding posts, transformer repairs, antenna kinks, condenser kinks, improving old broadcast receivers, eliminating interference, installing automobile radio, radio-servicing and trouble-shooting. The short waves, building all-wave and short-wave receivers tables of information, data codes, and complete detailed index for instantly finding any point, fact or information you want to know about.

Satisfaction Or Money Back

Send No Money NOW

POPULAR SCIENCE MONTHLY publishes this book. Do not hesitate to send for it because WE GUARANTEE that if you are not satisfied we will send your money back to you. Cloth bound, 256 pages, hundreds of simplified drawings and diagrams. Send no money now unless you prefer to. Pay the postman when the manual comes to your address.

POPULAR SCIENCE MONTHLY Dept. 12
353 Fourth Avenue, New York.

Send me the NEW book, RADIO EXPERIMENTER and BUILDER. I will pay postman $2.00 plus a few cents postage when the manual arrives—you GUARANTEE that if I am not satisfied with it you will refund my money if I return it within ten days. (If you prefer to pay now send $2.00 with order.)

Name . . . . . .

Address . . . . . .

City . . . . . State . . . . . .

Orders from outside United States must be accompanied by $3.00

Please mention POPULAR SCIENCE *when writing to advertisers.*

POPULAR SCIENCE *Classified* OPPORTUNITIES

MONEY-MAKING, MONEY-SAVING

Classified Ads only 35c per word per insertion, payable in advance. Minimum ad 10 words. To be included in February issue copy should be in our office by December 8th. February issue on sale January 1. POPULAR SCIENCE MONTHLY—351 FOURTH AVE.—NEW YORK CITY

ADVERTISING

MAIL-ORDER or agent ad reaching 1,000,000 families throughout United States $14.00 inch. Newspaper, magazine, mailing-list, ratebook free. Chicago Advertising Agency, 20-SP West Jackson, Chicago.

LEARN Advertising at home. Easy practical plan. No text books. Common school education sufficient. Interesting booklet and requirements free. Page-Davis School of Advertising, 1315 Michigan, Dept. 1742, Chicago.

YOUR Ad in Popular Science Monthly will produce profitable business for you. Rate is only 35c a word. Write for details. Dept. A-1, 353 Fourth Ave., New York City.

ADVERTISE 24 words 148 newspapers, $6.50. Lists Free. Advertising Bureau, 4515-P Cottage Grove, Chicago.

20 WORDS, 10 magazines, $2.00. Goodall, 37 Gardner, Vallejo, California.

AGENTS WANTED

RAWLEIGH Men make good money. Supply everyday household necessities to Rawleigh routes of 800 family users. Ambitious men can make good earnings at start. We furnish everything but the car. Write today. Rawleigh's, Dept. A-A-PSC, Freeport, Ill.

BIG Money applying initials on automobiles. Easiest thing today. Free samples. If you sell printing and advertising specialties we have an excellent sideline featuring Decalcomania Name Plates in small quantities. "Ralco", 127 Atlantic Ave., Boston, Mass.

AGENTS Opportunity make money, book containing 127 successful business plans home-office; send for free introductory booklet, Elite Co., 214-A Grand St., New York.

WILL you give us 5% first $600 you make? Afternoons free! Work home! $1,000 month reported (exceptional fulltime). Expect surprise! National, BX1240, San Bernardino, Calif.

SOCIAL Security. Your name and number stamped on a beautiful etched bronze plate. Also accident identification card and leatherette case. Complete 20c. Address—Name Plate, 338 Tremont St., Boston, Mass.

GOOD Paying business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave G, Decatur, Ill.

SELL Nylon Hosiery and Famous Snag-Protected Silk Hosiery. Sensational profit opportunity. Write fast now for sample stocking. American Mills, Dept. F-196, Indianapolis, Ind.

AMBITIOUS School Seniors—Sell Classmates the "tops" in Graduation Name Cards. Best Commissions. Free Cards. Agencies going like wildfire. Hurry! Craftcards, Box 235-M, Pittsburgh, Pa.

STRANGE Chemical Sponge cleans wallpaper like magic. Banishes housecleaning drudgery. Sensational seller. Samples sent on trial. Rush name. Kristee, 131, Akron, Ohio.

SCHOOL Seniors—Sell graduation cards. America's largest, fastest-selling, low-priced display. 35% commission. Free cards. Universal Engraving & Printing, Box 745-PS, Pittsburgh, Pa.

COMIC Clever Xmas Cards. Straley, Dept. S, 1017 Mulberry, Springfield, Ohio.

BUY BY MAIL

Looking here for mail order bargains is like looking for food at a banquet. It's the natural thing to do! There's many worthwhile opportunities on these pages. You'll find all kinds of attractive buys . . products and services for your home, car, radio, work shop, camera, hobbies and what not . . . in fact everything you need for your personal family or business use at low prices.

Please mention POPULAR SCIENCE CLASSIFIED when writing to advertisers. You will be treated fairly and courteously.

WINDOW Sign Letters. New "Roman" Style. Large sizes, penny each, absolutely beautiful. Free samples, new catalogue. Atlas, 7941 R Halsted, Chicago.

YOU'LL Like Resilvering Mirrors, Tableware, making Chipped Glass Nameplates, Signs. Outfit prices. Sprinkle, Plater, 910, Marion, Indiana.

SELL dresses low as $1.24. Hundreds sensational bargains. Actual samples free. Send dress size, age. Harford, Dept. F-33, Cincinnati, Ohio.

FREE water and our concentrates make 72 products. We supply labels, bottles. Enormous profits. Qualco, F-20030 Russell, Detroit.

AGENTS, Managers Wanted. New invention sells at first sight. Only reliable men wanted. Full instructions given. Box 379, Royersford, Pa.

MEN'S—Ladies' Topcoats 35c, Winter Coats 40c, Suits 88c, Pants 32c, Dresses 10c. Other bargains. Catalog Free. Portnoy, 566 W Roosevelt, Chicago.

AGENTS—300% Profit selling Gold Leaf Letters, stores and offices. Free samples. Metallic Letter Co., 437 N Clark, Chicago.

"SLIPNOT" Tie free 55c sample as samen only. Slipnot Tie Manufacturers, 39 10th Street, Philadelphia, Pa.

FREE Mexican Curios Novelties. 100% profit! Marquez, Apartado 1176, Mexico City.

SELL Men's Latex Products. Large Profits. Send $1.00 for samples. Peerless, 4050-AJ Broadway, Kansas City, Mo.

AIR CONDITIONING & HEATING

LEARN fundamentals of electric refrigeration. Learn to repair your own refrigerator and your neighbor's. Develop profitable sideline trade. Send $1.00 for clear, well illustrated, authentic manual of basic instructions. If you are not satisfied, return book for full refund. Refrigeration Library, Dept. 36, 5229 Cass, Detroit, Mich.

AIR Conditioning, Drafting, pays big. Home study course. Easy terms. Free booklet. Ohio Institute of Technology, Box 42, Greenville, Ohio.

ANTIQUES, RELICS INDIAN GOODS

25 GENUINE Indian Arrowheads, $1.00. Catalog, Geo. Holder, Glenwood, Ark.

10 ARROWHEAD, Wampum, Birdpoint, Scraper $1.00. 3 rare leaf Fossils $1.00. 4,000 bargains. Relics, Antiques, Firearms, catalog 10c (photographs of most). Museum, Richard, Ia.

12 BEAUTIFUL Select Prehistoric Arrowheads $1.00. List Free. Lear Howell, Glenwood, Arkansas.

SWORDS, Rapiers, Daggers, Pistols, Catalog 10c. Robert Abels, 860½ Lexington Avenue, New York.

AUTHORS' SERVICE

NEW Writers Needed! Free Test shows your ability. It's fun! We show what to write, help you sell. Rush postcard. No obligation. Comfort Writer's Service, Dept. 78-J, St. Louis, Mo.

MANUSCRIPTS revised—marketed—reasonable. Renseb-PS, 30 Church, New York City.

WRITERS! Send 10c for "Story Writing Self Taught." Worth $10.00. Gagnon Co., Dept. 52, 541 S. Spring, Los Angeles, Calif.

STORIES Revised, Marketed. Details free. Hursh, Box 8-1013, Harrisburg, Pa.

AUTOMOBILES

AUTOMOBILE Racing Book. Fifth Edition—Revised. Tells how to build dirt track bodies, frames, engines. Records, superchargers, rules, formula, plans, stock conversions, roadster racing, fast Fords. $1.00 postpaid; $1.15 C.O.D. Ray Kuns, Department 260, Madisonville, Cincinnati, Ohio.

WHIRLGAS Turbinator, $3, spins and vaporizes carburetor mixture. Guaranteed mileage increase any car 30%. Universally lent. Give make, year. Wrench installs 15 minutes. John Hanley, Manufacturer, 5719 Loraine, Detroit, Mich.

INCREASE the horsepower of your Ford V8 from 85 to 120 HP—without supercharging. Send $1.00 for detailed, simple instructions. Power Associates, P.O. Box 501, Wilmington, Del.

AUTOMOTIVE Drafting and Design pays big. Home study course. Free booklet. Ohio Institute of Technology, Box 43, Greenville, Ohio.

R & R MFG Co., Anderson, Indiana. Racing cars, midgets and speed equipment. Catalogue 25c, Fuel Chart 75c, Instructions $1.00.

AUTO SUPPLIES & EQUIPMENT

CONVERT your car to burn Diesel oil. Save up to 70% fuel costs. Cheap installation. Wonderful performance. Proven factory method. Different and better. Costs nothing to investigate. Write for free circular No. 3. Harrington Company, 201-204 Manchester Bldg., Portland, Oregon.

FUEL oil conversions — For automotive, marine engines. Write for free literature. Houston & Logan, 2112 Addison, Berkeley, California.

NEW Spark Plugs at ¼ price. Hurry! 811 East 31, Kansas City, Mo.

REFINE Used oil without cost. Particulars. C. Gerwin, Fairview, Oklahoma.

AVIATION

A&E MECHANIC'S Examinations. Test yourself! 450 simulated (multiple-choice) questions, answers. Airplanes, Power plants, Car. $1.75. Question-Air System, Kilgore, Texas.

BUILD and fly your own Motorcycle powered monoplane. Home. Easy. Cheap. Tested plans guaranteed. $1.00. Aerotech, Dearborn, Michigan.

GET into Aviation! Earn $3000 to $6000 a year as Pilot, Mechanic or Aircraft Engineer. We train you and assist Graduates in locating civilian employment opportunities in national defense. Big demand. School Government Approved. Write for information. Lincoln Airplane & Flying School, L06 Aircraft Bldg., Lincoln, Nebr.

AEROSLEDS, Blueprints, $4.00. Supplies. Send Stamps. Adastik Bro., Grand Rapids, Mich.

HOMEBUILDERS! Box 100 P-[illegible] Agar, South Dakota, Plans—Kits—Etc. Illustrated literature 10c.

BATTERIES, GENERATORS, ETC.

EDISON lifetime storage batteries for light and power. Eliminate and battery dimness. Long guarantee. All kinds rebuilt generating plants, motors and miscellaneous articles at bargain prices. Free interesting literature. W. Hanley Smith Company, Croton Falls, N. Y.

GENUINE Edison Batteries for power, light. Non-acid, fifteen year life. Five year unconditionally guaranteed. Low prices. Complete lighting plants. Free literature. Box 24, Company, 87 Sterling Ave., Yonkers, New York.

BOATS, OUTBOARD MOTORS, ETC.

WELCH Boats — America's Finest — Two Thirds saving. Build your favorite boat by the Welch System. 10c brings you a complete catalog showing 32 designs. Welch Boat Company, Station K-9, Milwaukee, Wis.

MARINE Power. Easily convert any Ford motor. 10c. [illegible] Parts and Kits. Complete Catalogue 25c (coin). Osmithson, 3646-P Lawrence St., Philadelphia, Pa.

OUTBOARD Motors. Used and Rebuilt. Save money. Used parts. Bargain list free. Crandall-Hicks, 846 Commonwealth, Boston, Mass.

MARINE Conversion Parts for all auto engines. Buy here and save. Conversion Parts Co., 377 Adams St., Boston, Mass.

KAYAKS, Outboards, Rowboats, Duck Boats. Weldwood ready-cut kits. Catalog. [illegible] Boats, M[illegible], N. J.

SAILKITS. 100 square feet $5.95. Canoe, Boat Supplies, reasonable. Catalog. Alan Clarke, 98 Chambers, N. Y. C.

FORD Marine conversions. Catalog 10c. Lehman Engineering Co., Dept. A, Newark, N. J.

BODY BUILDING—COURSES

WESTERN YOGA "Uncommon" deep breathing prevents disease, makes even old people physically and mentally fit, younger looking. Free folder. P[illegible] Works, 5520 Metropolitan Station, Los Angeles, Calif.

BAR BELLS. Dumbbells. Exercise equipment. Courses. Special Offers! Free booklet. Good Barbell Co., Dept. 8, St. Louis, Mo.

SNORERS details. Secret Formula. [illegible] Works, 5520 Metropolitan Station, Los Angeles, Calif.

BOOKS, PERIODICALS

BUSINESS and trade magazines. Current copies. More than 275 different publications, representing over 50 trades, professions, hobbies, etc., to choose from. List with prices free. Commercial Engraving Publishing Co., 348 North Ritter Ave., Indianapolis, Indiana.

AERO Blue Book, up to date edition gives specifications hundreds commercial, private, military planes and engines. Illustrated. Information valuable for students, engineer, aviation enthusiasts. Send $1.00 now for your copy. Aircraft Co., Dept. 1PS, Arcade Bldg., St. Louis, Mo.

6c BUYS back dated magazines, Foreign, Domestic. Art. Also over 100,000 used and new books on Engineering, Science, Chemistry, Geology, Law, etc. Catalog 10c (refunded). Cicerone's Book & Magazine Center, 863 First Ave., New York City.

EDUCATIONAL Books sold cheaply or rented for small fee. Books bought. Money back guarantee. 4,000 Bargains. Catalog Free. (Courses Bought.) Lee Mountain, Pisgah, Ala.

ART Pretty Girl Pictures. Mixture new series, complete set 36 pictures $1.00. 3 sets $2.00. Each picture postcard size. Satisfaction guaranteed. Harlem, Box 16, Station J, New York. Dept. A 11.

LOVE Diary (Ruthbelle)—deluxe. $1.00. Economy Edition (illustrated). Specimen. 25c. Private Press. 146 VP, Palisades Park, N. J.

STODDARD'S Books, Sixth Editions. Circulars! 174. Route 4, Indianapolis, Ind.

ART Books (New, Used, Out-of-Print, Rare) Promptly Supplied! Lowest Prices! Send for Free Bargain Catalogues! Old Prof's Book Shop, 516, Arcadia Court, Pontiac, Mich.

THRILLING Cuban, Mexican, Art Pictures, Books, miscellaneous. Samples, Lists 50c (refunded). Jordan, 135 Brighton, Boston.

ARTISTIC Photographs. List, sample, dime. Parisetta, 33 Munn Building, Rochester, N. Y.

SCREWBALL Magazine. Three months, 25c. 315B Haas Building, Los Angeles, Calif.

INTERESTING Photographs! Male or female models! Books! Ace, 2039 E. 21st, Oakland, Calif.

STEREOSCOPIC (three dimensional) Art Photos. Particulars for stamp. Oddity House, St. Petersburg, Fla.

PRETTY Girl art photos, books, novelties. Big assortment $1. Catalog 10c. F. S. Braun, 353 W. 47th, Chicago.

SNAPPY books, pictures, novelties, etc. Where to get. We tell you. List only 10c. Ese Co., Dept. A, Baltimore, Md.

ART Studies, 18 Large Pictures $1.00. Catalog 10c. Gross Specialties, B, Carnegie, Pa.

FREE Pamphlet Library Plan—10c. Rensark, Box 105P, Arlington, N. J.

ART Studies. Art Film [illegible]. Samples, catalog, 25c. Shutt Sales, Strasburg, Ohio.

ART Photos Interest You? See Capitol Negatives advertisement under Cameras.

BUILD IT YOURSELF

PROFESSIONAL Midget Racers, Two-passenger tandems. Midget motorcycles, motorscooters. Parts, plans, wheels. Handbook catalog—10c. Illustrated plans 20c. Midget, Box 616 RR, Chicago.

BUILD power Scooters, midget cars. We supply tires, wheels, motors. Lowest prices. Send 10c for plans, etc. Midget Own Devices, Dept. 1-E, 530 North Parkside, Chicago.

BUILD your own Tractor from secondhand automobile parts and save money. You can't go wrong. Write Nolan's Garage, East Wareham, Mass.

MOTORSCOOTERS, Midget cars! Easily built. Complete plans and literature on wheels, tires, motors, transmissions, etc., 10c. Homaker, Masontown, Pa.

MIDGETS, Motorscooters. 50 used motors, $5.00 up. List, 20c. (List parts, plans included.) Midgets, Box 543 K, Zanesville, Ohio.

TOOL Post grinding attachment, castings and instructions for building same, $3.50. R. Richler, 3434 Elaine Pl., Chicago, Ill.

LATHE Tool Post Grinder. Castings and Building Instructions, $2.50. Details 10c. Star Shops, Kingfisher, Okla.

BUSINESS OPPORTUNITIES

PLASTEX Industries offer industrious person an opportunity to start a business of their own, manufacturing art goods, novelties and utility products in Plastex and marble imitation. Material makes regular 10c store seller. Rubber moulds furnished for speed production. Small investment brings big returns. We are now placing big Xmas chain store orders with manufacturers. Ambitious men have chance for real prosperity. Plastex Industries, Dept. 2, 1085 Washington Ave., New York, N. Y.

BEGINNERS & New people may receive excellent results from only one idea from my book Sel-Met-Ad. Tells many methods I used to make over three million dollars worth of merchandise from. This book To Tombstones. Postpaid One Dollar. Special Offer. Over one hundred tested formulas. Ingredients to Chemicals. Free. W. M. Davis, Memphis, Tenn.

WANTED—men to cast Christmas Goods, 5 and 10c Novelties, Toy Autos, Ashtrays, etc. Can be done in any spare room, basement or garage and no experience necessary. A rare opportunity to devote spare or full time to profitable work. Write Dept. E, Metal Cast Products Co., 1696 Boston Road, New York City.

MANUFACTURE new wood plastic gifts, plaques, novelties for profit. We furnish material and rubber molds for big production. Sample mold model large scottie dog with illustrated molding circular catalogue new flexible molds, 25c stamps or coin. New Era, 1052 North Irving Pk., Chicago.

GOOD Paying Business silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. E, Decatur, Ill.

MECHANICALLY Inclined Men—Own and operate general Appliance Repair shop. Complete, illustrated course shows you how. Welding, Refrigeration, Motor repair. How to get business, etc., all phases covered. Free literature. Christy Supply, Dept. J-1, 2835 N. Central Ave., Chicago.

START Home Business making statuary, plaques, art goods, novelties, souvenirs, concrete pottery, garden furniture, artificial marble flooring, liquid marble. Make your own flexible molds. Amazing profits. Valuable folder free. Creative Publishers, P4, Glencoe, Illinois.

MAKE Novelties, molds, make toys from old inner tubes, rags, newspapers, sawdust, [illegible] Ready [illegible] Booklet 36 pages 10c refunded. [illegible] 1310 S16A, Omaha, Nebraska.

MAIL Order business course shows you how to make money, spare or fulltime. Teaches professional mail order technique —not money catching schemes. Free details. Nelson Co., 500 Sherman, Dept. N-607, Chicago.

BEGINNERS, Why be unemployed? Be in business for yourself! Right in your own home! $30-$60, weekly! Lifetime Opportunity! Details? 25c (Coin Only) M. Lithe, Washington Bridge Station, P. O. Box 134, New York City.

MAKE Artificial marble, glazed tiles, sanitary flooring, superhard figurines, rubber molds, moldless pottery, chemically stained cement. Uncanny secrets. Samples 3c, expect surprise. Payn, 945 Grande Vista (Hesan 15), Los Angeles, Calif.

COLOR Concrete with chemicals. Stone, Cement Artistry. Welding wire. Spin concrete pottery. Bench, Garden Ornaments. Cold glaze, receptacles, machines. Sample. N. Hollywood Concrete Craft, 4310 Wonderland, Hollywood, Calif.

MAKE colorglazed concrete pottery, cemetery products, tile floors. Basement waterproofing. Other projects. Booklet, forms, plates, details 10c. National Potteries, Minneapolis, Minn.

METALIZING Baby shoes makes you money! Simple. New. Perpetual market. Small investment. Big profit. Full particulars free. Novelty Metalizers, Box [illegible] N. Church Street Annex, New York.

BE Prosperous. Achieve your ambition. Properly used spare time does it. New folder explains how, 25c prepaid. Money back if not benefited. Business Builders, 435 D Riverside Drive, New York City.

WILL you give us $5, if it $600 you make? Afternoons free! Work home! $1,000 month reported (exceptional — fulltime). Expect surprise! National, BK1240, San Bernardino, Calif.

START 1942 Right! Specialty manufacturing offers greatest opportunities! Double your income in sixty days. Interesting literature fully explains. Miller, Analytical Chemist, Tampa, Florida.

FREE! Details of new highly profitable plastic business. Big Profits. 5c material makes $1.00 articles. Full or spare time. Write Comp-Tex, Box 786-F, St. Louis, Mo.

127 WAYS to make money in home or office, business of your own. Full particulars free. Elite Co., 214-A, Grand St., New York.

BIG Paying Mail Order Business in your own home. Full Particulars with moneymaking magazine, 3c postage. B. Scott Service, Toronto 10, Canada.

TESTED money making mail order plans. Formulas. Trade secrets. Postal brings Big Money By Mail magazine. Venkey Service, R. 11, Leman, Mo.

PAINT signs for profit with aid of Lettering Patterns. Free literature. Sample alphabet 5c. Display Letters Company, Box 25-S, Ft. Hamilton Station, Brooklyn, N. Y.

MOLD plaster novelties. Big profits. Rubber molds and materials. 24 page catalog and sample XL mold material Free. Plastics, 711 Neely, Muncie, Ind.

LIQUID Marble — Marvelous, colorful! Brushed, sprayed, molded. Rubberlastic molds! Composition Flooring! Particulars free. Marbleizing Service, Edwards, La.

FREE—200 clever mailorder, homework, local business offers—all snappy moneymakers. Lewis Co., 828-A Carpenter, Oak Park, Ill.

HANDY men. Earn money home operating Community Fix-It Shop. Stafford, 708 Rawlings, Carbondale, Ill.

$50 $100 WEEKLY using Sawdust. Cement. 943 Arthur, Rochester, N. Y.

"SECRET How You Can Prosper." 10c. Lightning Speeder, Streator, Ill.

HOW and where to obtain capital. Particulars free. Star Service, Wapakoneta, Ohio.

INCORPORATE your business. Sell shares. Raise capital. Free details Corporation Finance Co., Box 1472-S. Wilmington, Del.

MAIL and distribute circulars, wonderful opportunity. Miracle Factories, Conshohocken, Pa.

TURN Tin cans into money. Instructions 25c. Cheney, 1130 E. 16th St. Jacksonville, Fla.

REPRESENT a Finance Company. Particulars free. Nebraska Finance Co., Lincoln, Nebraska.

BUY It Wholesale. 1,500,000 items. Guide, postpaid 25 cents. Buyer's Service, Box 3, Racine, Wis.

SWISS Music Box Works—$1.35 to $2.19. Suitable for many novelties. Mermod Manufacturers, 147 West 46th St. New York.

WHERE to buy at lowest wholesale prices. Information free. Torena, Box M-312, Bayonne, N. J.

REAL Manufacturing Formulas. Particulars free. Chemist, 226 Gordon Avenue, Syracuse, N. Y.

SOAPMAKING. Learn Home. No Machinery. (4 samp) Puveis, DK-4346 Bartlett, Milwaukee.

PROFESSIONAL Mailorder magazine—15c. Mailorder Directory—15c. Kraft Publications, Syracuse, N. Y.

WHOLESALE prices. Watches, Typewriters, Pens, Movies, Cameras. Simmes, Warwick, N. Y.

RAISE Angora Rabbits. Wool brings $5.00 pound. Particulars free. Grinstead, Carrollton, Ill.

MAILORDER Tips sent free. S. Velchek, 1098 Gerard Ave., New York.

BUSINESS SERVICE

WANT more business? Advertise your product or service in these columns. For details write today to O. K. Kelly, Classified Adv. Mgr., 353 Fourth Ave., Dept. 2B, New York City.

HOLLYWOOD or Los Angeles mail address, Business or Personal, $1.00 a month. California Information Service, 4413 Santa Monica Blvd., Hollywood, Calif.

WE Collect Notes, Accounts everywhere. No charges unless collected. May's Collection Agency, Somerset, Kentucky.

CAMERAS, PHOTO SUPPLIES

WRITE Bass First—Largest stocks of fine cameras (still and movies) in the U. S. A. Latest Argus C-3 with coupled range finder, synchro flash, 50mm. F 3.5 lens, also 75mm. Bausch & Lomb Telephoto F 5.6 also coupled to range finder. $66.55 value, price $49.50. Unconditionally guaranteed. Cowhide Eveready case $4.75. V. P. Ihagee, F 4.5 Anastigmat, Pronto shutter $16.75. Whatever you want in photography write Bass first. Liberal trades. For over thirty years money back if not satisfied. Bass Camera Company, Dept. S.P., 179 W. Madison Street, Chicago, Ill.

CAMERAS And supplies. Free illustrated catalog listing everything photographic—still and movie cameras, films, lenses, enlargers, meters, supplies—at tremendous savings. Hundreds of bargains. All guaranteed. We take your old camera or equipment in trade. Write now for your free copy of our newest money-saving bargain book—just out! Limited edition. Hurry! Central Camera Co., (Photographic Headquarters since 1899), 230 S. Wabash, Dept. A-18Z, Chicago, Ill.

AMATEUR Photographers attention. Improve your hobby of picture taking and learn how to make money with it. Write today for our 40-page book catalog and a sample copy of American Photography, enclosing ten cents for postage. Contains articles and pictures of the world's foremost writers and pictorialists. Camera House 161, 353 Newbury St., Boston, Mass.

OIL coloring photographs a fascinating hobby or profitable business. Learn at home. Easy simplified method. Previous experience unnecessary. Send for free information and requirements. National Art School, 1315 Michigan, Dept. 1741, Chicago.

MAKE money in photography. Learn quickly at home. Easy plan. Previous experience unnecessary. Common school education sufficient. Booklet and requirements free. American School of Photography, 1315 Michigan, Dept. 1741, Chicago.

ART Photo Enlargements—make your own prints of beautiful girl models from our 35mm fine grain negatives. Large assortment $1.00. Details 10c. Capitol Negatives, Box 601A, Washington, D. C.

SPEED-O-COPY groundglass focusing attachment for Leica, Contax, Argus C-3 and C-2. Send for literature. D. Paul Shull, Dept. PS-1, 388 So. Union Ave., Los Angeles, Calif.

35MM BULK Film! 25 ft. Eastman Plus X $1.00. Reloaded Cartridges—3 for $1.00 postpaid. Order now. Pacific Coast Film Co., 1510 N. Sierra Bonita, Hollywood, Calif.

CAMERA Repairing. Bellows made to order, shutters repaired. Bellows made to fit all standard cameras! United Camera Co., Inc., B-1515 Belmont, Chicago.

WE pay highest prices for cameras, accessories, movie equipment, binoculars. Estimates Free. Trade-Ins. Brenner Photo, 941 E Pennsylvania, Washington, D. C.

ENLARGER $1.50. Enlarges eight times size of small negatives. Guaranteed. Paramount Sales Company, 60 Dudley St., Boston, Mass.

SOLAR Enlargers for Prize Winning Prints. Amazing performance. Enlarging Treatise free. Ask your dealer. American made by Burke & James, Chicago, Ill.

NATURAL color your snapshots—complete outfit 25c. Gilbert, Box 6165, Cleveland, Ohio.

"PRESS Cards" "Press Tags" "Catalogues" Supplies. 1834 Eleventh, Washington, D. C.

PHO-NEG photograph, negative file holders save time, lost damage. Four popular sizes. Samples 10c. Pho-Neg, Stamford, Conn.

"PRESS Tags, Cards, etc." Press Supplies, 1834 Eleventh, Washington, D. C.

CHALK TALK STUNTS

LAUGH producing program, $1.00. Illustrated catalog 10c. Cartoonist Balda, Oshkosh, Wis.

CHARTERS

DELAWARE charters complete service $35.00. Submitted forms. Chas. G. Guyer, Inc., Wilmington, Del.

CHEMICALS & APPARATUS

CHEMISTRY Laboratory apparatus and chemicals for industrial, analytical, and experimental laboratories. Complete supply service for students taking correspondence school chemistry courses. Send 3c postage for free 44 page catalog. Dept. M26, Biochemical Supply Co., 1176 Mt. Hope Ave., Rochester, N. Y.

YOUR chemical problems solved. Any formula tested, developed. Confidential. Reasonable charges. Chemical Engineering Associates, West Hartford, Conn.

CHEMISTRY Set, complete home laboratory. 30 pieces $1.00 postpaid. Free catalog: chemistry, mineralogy, microscopes. Tracey Laboratories, Evanston, Ill.

HANDBOOK for Chemical Experimenters, hundreds of experiments, illustrated 30c. Experiment booklet with chemical catalog 10c. Reading Scientific Co., Reading, Pa.

MONTHLY Chemistry Magazine, 6204-N Hermitage-E, Chicago. Year 75c. Sample 10c.

25 RESISTANT Test Tubes, metal holder, experiments, 25c. Scientific Exchange, Brooklyn, N. Y.

SOILLESS Colchicine Plant Experiments Magazine Subscription $1.00. Quamtop, Wellesley, Mass.

CHEMISTS. Chemical questions answered $.25. Formulas, analyses. Lewitsky, 26 Erwin Place, New Britain, Conn.

CATALOG 3000 Illustrations 10,000 prices. Sent for 50c. Laboratory Materials, 7317 Vincennes, Chicago.

LUMINOUS Paints will glow in dark. Five colors. Fairmount Chemical Co., 136 Liberty St., New York City.

CHEMICALS—5c quantities, apparatus; Catalog 5c. Fleischer's Laboratories, Medford, Mass.

REMARKABLE wetting agent-formulas, $1.00. Cambridge Laboratories, B-2, Wellesley, Mass.

SPECTROSCOPE for quick chemical analysis $2.50. McCutting Sons, Campbell, Cal.

DETECTIVES

DETECTIVES—Work home—Travel. Experience unnecessary. Write, Wagoner, 2640 P Broadway, N. Y.

DOGS, BIRDS, PETS

ST. BERNARDS—all breeds—details free! Book 104 photos, descriptions recognized breeds 25c. Royal Kennels, No. 30, Chazy, N. Y.

ST. BERNARD puppies. Champion sired beauties. A. K. C. Franklin Young, R1, Riverhead, Long Island, New York.

GREAT Dane Pups on approval. Time Payments. Kalmar Danery, Stone Mountain, Ga.

EDUCATIONAL & INSTRUCTION

WELDING opens the way to good pay and future in important industries. Growing need for trained welders. Prepare now. Practical, personal training spare time at home and Chicago. Write for free facts. Utilities Engineering Institute, 1314 Belden, Dept. 321, Chicago.

ANNOUNCING new home study course in commercial baking. Good field. Nearly depression proof. Common school education sufficient. Send for free booklet "Opportunities in the Baking Industry" and requirements. National Baking Institute, 1315 Michigan, Dept. 174, Chicago.

WELDING—Electric Arc. Learn quickly by actual practice at Hobart Welding School. Individual instruction at bare cost of materials used. 50c in stamps brings valuable welding lessons postpaid and full particulars. Hobart Welding School, Box P 126, Troy, Ohio.

IMMEDIATE Openings for arc welder students in expanded famous Lincoln school. Big opportunity for starting arc welding. Now in big demand. Bright future. Write Lincoln Welding School, 12818 Coit Rd., Cleveland, Ohio.

ARITH-MAGIC—(Not a machine)—Solves all problems in Arithmetic with unfailing accuracy in 1/10th the usual time, with 1/10th the usual effort. Postpaid One Dollar, worth a hundred. Wonderful Gift. Arith-Magic, Dept. 32, Maywood, Ill.

BE a doctor. Learn chiropractic. Fast growing profession. Write for catalog. Dept. C., Texas Chiropractic College, San Pedro Park, San Antonio, Texas.

CLINICAL Laboratory Technic taught in your own home. Practice outfit supplied. Bulletin free. Imperial Technical Institute, Box 494 B, Elkhart, Ind.

FINGER Print Experts earn big pay! Learn Easily at Home. Low Cost! "Crime Book" Free. Write stating age. Dept. 212, Inst. Applied Science, 1920 Sunnyside, Chicago.

FOR an Extremely profitable lifetime business operate a Collection Agency-Credit Bureau. Inexpensive short course. Write Cole Associates, Syracuse, N. Y.

CIVIL Service Jobs. $105—$175 month. Prepare now for examinations. List positions—full particulars free. Franklin Institute, Dept. F32, Rochester, N. Y.

ENJOY Health. Become Professional Equilibrist. Free health book. Write! Emil Knoff, 219461 North 52nd St., Milwaukee, Wis.

TOOL Designing. Taught the practical way. Pay as you learn. The Tool Engineering Co., 630 N. Taylor Ave., Oak Park, Ill.

DESIGN Engineering pays big. Home study course. Low cost. Easy terms. Free booklet. Ohio Institute of Technology. Box 44, Greenville, Ohio.

NOTARY Public work is dignified. Make more money. Short course. Diploma. Booklet free. Notary School, K-36 W. Washington St., Chicago.

PART Time Bookkeeping pays big. Easy payment course. Fireside Educational Institute, 5642-S South Homan, Chicago.

ELECTRIC SHAVERS

ELECTRIC Razor Sensation. Underwood Dry Shaver, $5 Value, only $2.95 Postpaid. Guaranteed. Modern Sales Co., Dept. PSM, Homer, N. Y.

SCHICK Electric Shavers $6.50. Newly reconditioned. Guaranteed one year. [illegible] Shaver Shop, 1538 Franklin Street, Oakland, Calif.

ELECTRICAL SUPPLIES & EQUIP.

ELECTRICAL Drafting pays big. Home study course. Free booklet. Ohio Institute of Technology. Box 44, Greenville, Ohio.

FLUORESCENT Bed Lamp $6.25 complete. Catalog free. J. Mider, 1434 Jackson, Chicago.

ELECTRIC Pencil. Writes—Engraves all Metals. $1.00 postpaid. Beyer Mfg., 4415 C Cottage Grove, Chicago.

FREE 1942 Catalog—[illegible],000 electrical bargains. LeJay Manufacturing, 821 LeJay Bldg., Minneapolis, Minn.

ENGINES, MOTORS, ETC

1/4 HORSE, 3450 Speed. Repulsion Induction Alternating Motors $10.75. 500 Watt Alternating Generators $24.50, other sizes. Butler Electric, 1885 Milwaukee, Chicago.

AIR Compressors 1 1/2 x 1 1/2, $4.00; 2x2 $7.00; 2 1/2 x 2 1/2 $8.00. Electric drills 1/4 in. $5.95. Free Folder. Nationa[illegible], 1915 S. State, Chicago.

½ HORSE, 110 volt, induction motors, Rebuilt, guaranteed $8.75, other sizes. Wilmot Auto Supply, 2347 St. Paul Ave., Chicago

BARGAINS—Welders electroplating motor generators, guaranteed, liberal terms. [illegible] Roberts Box P-121 Troy Ohio.

WINDING Data, 725 motors, single and three phase, $1.00. Motor Data Co., Box 7631, Kansas City, Mo

FARM MACHINERY

BUILD powerful tractor of used parts. Buick motor Fordson tractor axle. Starter, Lights, Pulls Fordson equipment. Drawings Instructions $1.50 L. C. Zellars, Route 1, Rochester, Mich

FARMS, OTHER REAL ESTATE

GOOD Farm Bargains Washington Minnesota, Montana, Idaho, Oregon, North Dakota. Dependable crops, favorable climate. Write for literature and lists describing typical farms for sale. Specify state. J. W. Haw, 130 Northern Pacific Ry., St. Paul Minn

FARMS! Catalog 1200 bargains Wisconsin to Maine and South to Florida mailed Free. Strout Realty 255 ZB 4th Ave New York City. For California Oregon Washington catalog write Strout Realty, 641-ZB S. Spring St., Los Angeles Calif

SEE The Highlands of Louisiana. Choice cut over land selling on liberal terms. Descriptive book sent upon request. Long-Bell Farm Land Corp., 876 R. A. Long Bldg., Kansas City, Mo

40 ACRES near White River unimproved, poultry land $100. $5 down, $5 monthly. Free list and literature. Hubbard, 300 Grossman Bldg., Kansas City, Kan

FIELDGLASSES, TELESCOPES & MICROSCOPES

LENSES Build your own telescope, field glass, microscope, riflescope etc. Assortment of fifteen lenses—$1.00 postpaid. Slightly chipped on edge. Satisfaction absolutely guaranteed. American Lens Company 336 N. Mayfield Chicago

ASTRONOMICAL Telescopes, binoculars, cameras, microscopes bought, sold, repaired. Send 10c for list of instruments desired. Rasmussen Box 294 Amsterdam N.Y.

TELESCOPES Microscopes Binoculars, bargain catalog free. Brownscope Co., 136 West 48th St., New York

FOR THE HOME

ORNAMENTAL Hand-Made Bowl of Mexico! Grows all year, indoors, outdoors. $1.00 pair, delivered. Springer-Importer, 210 S. El Paso, El Paso Texas

VACUUM Cleaners—New and Rebuilt, Parts, Attachments, Lowest Prices. Vacs. P.O. Box 61, Clifton, N. J.

EXTRA Large beautiful, pink, white sea shell, 10"x11". Prepaid $1.00. Shells, Box 3494, Jacksonville, Florida.

FOR INVENTORS

INVENTORS Take first step toward protecting your invention without obligation. Send for free "Record of Invention" form and free "Patent Guide" containing instructions on how to patent and sell inventions, details of search service, convenient payment plan. Write today. Clarence A. O'Brien, Registered Patent Attorney, 22A-A Adams Building, Washington D. C.

PROTECT Your Ideas Before applying for patent. Assure against false priority claims. Negotiate sale or manufacture in safety. Protectogram Method provides simple, tamperproof, incontestible evidence, basic dates, even without a witness. Every inventor should know and use it. Full instructions, $2 prepaid. Money-back Guarantee. J. C. Thomas, 434 Weightman Bldg., Philadelphia

INVENTORS, Unpatented inventions now salable with positive safeguards under patent laws. New, low-cost procedure. Complete details, free. American Patents Corporation, Dept. 12, Washington, D. C.

HAVE you a sound practical invention for sale, patented or unpatented? If so, write Chartered Institute of American Inventors, Dept. 3-A, Washington, D. C.

CASH for practical ideas and inventions. Mr. Ball, BB-9441 Pleasant, Chicago

FORMULAS, PLANS, ETC.

AUTHENTIC Formulary, 924 pages. (Illustrated.) Recipes, Instructions—10,000 profitable products. $1.00 postpaid or C.O.D. (Foreign $1.25.) Catalog 3c. Adams-Brown, Chestnut Hill, Mass

NEW! Foaming (Soapless) Formulas. Also one ingredient formulas—no manufacturing! Information free. C. Kinford, Wayne, Pa.

300%—1000% Profit using Victor exclusive analytical formulas, processes! America's twenty specular specialties. Unusual plan. Brochure Free! Victor Race, Dept. E, Norwalk, Connecticut

NEED a chemist? Competitive formulas. Development, Consultant Chemist, Claymont Delaware

SIMPLIFIED Formulas — Newest kind. Surprising literature free. Baran, Bay City, Michigan

FORMULAS—Latest, best. Analysis. Literature free. E. Belfort, Engineering Bldg., Chicago.

1,000 CHOICE Formulas—25c, 10,000—$1.50. Hill, 6020 Harper, Chicago.

FORMULAS All kinds. Guaranteed. Catalog free. Kemico, 500, Parkridge, Ill.

GAMES, ENTERTAINMENT

PLAYS, operettas, musical comedies, complete minstrels, first parts with song programs, blackface skits, vaudeville acts, monologs, dialogs, recitations, juvenile plays and songs, musical readings, entertainments, make-up goods. Catalog free. T. S. Denison & Co., 203 N. Wabash, Dept. 26, Chicago.

HELP WANTED

WRITE For Free Fabric Samples amazing stainproof tablecloths. Clean with damp cloth. Require no ironing. Beautiful patterns. Look expensive, long wearing, low priced. Commissions big. Also complete dress line. Melville Company, Dept. 3036, Cincinnati, Ohio.

LOCAL Agents wanted to wear and demonstrate suits to friends. No canvassing. Partial payment plan. Up to $12 in a day. Experience unnecessary. Valuable demonstrating equipment, actual samples Free. Progress Tailoring, Dept. A-231, 500 Throop, Chicago

MEN Wanted—Auto-Diesel Mechanics. We pay your railroad fare to Nashville. Let us train you to be an expert mechanic and help you get a good job. The cost to you is small. For free booklet write Nashville Auto Diesel School, Dept. 240, Nashville, Tenn

SERVE open press as press correspondents. Space time good earnings. Offer free lance. Press Card. In your name, the contest. [illegible] Press Bureau, Chief, 4316C Eleventh, Washington, D. C.

AT home, your own manufacturing business, making popular $1.00 novelties. Cost you 3c to 15c. Everything supplied. Write So-Lo Works, Dept. S 624, Cincinnati Ohio

START own typing service. Four business building ideas, 50c. Richard Service, 4340 Maple, Dallas, Texas

LEARN Sign Making, showcard writing, new easy way, sell stores. Details free. [illegible] R. B. 148, Greenville, Ky.

HIGHGRADE SALESMEN

BIG money daily. Sell business stationery, advertising specialties, book matches, gummed tape, 700 other necessities to stores, offices, professional men. 33⅓% profit paid daily. Best line of its kind. No experience needed. Big outfit free. David Lionel Press, 312 S. Hamilton, Dept. 41, Chicago

ADVERTISING Book Matches offer liberal earnings—full, spare time. Experience unnecessary. Factory direct. Low prices for fine quality, quick deliveries help get orders. Faster repeats. All business firms prospects. Free outfit. Instructions. American Match & Printing Co., Dept. 71, 4622 So. Trumbull Ave., Chicago.

DISTRICT Representatives — permanent territory, a business of your own—by LaSalle Extension University, a correspondence institution. Thoro training, much national advertising, liberal commission. Requirements good personality, ability to counsel with prospects, will to work, a car. John D. Morris, 4111 S. Michigan, Chicago

MAN with car to establish retail store route. Openings almost every locality. Handle orders for nationally known manufacturer-jobber. Average 40% commission. Steady big pay opportunity. Sales experience unnecessary. World's Products Co., Dept. 321, Spencer, Ind.

YOUR ad in this Classification will reach productive sales-getters for your products or services. Rates on request. Popular Science Classified, 353 Fourth Ave., New York N. Y.

ANOTHER Collection System Boom plan established over fifteen years. Big Commission. Double Bonus. 3034d Calvert St., Baltimore.

BLADES Big profits. Best quality. Factory prices. Ace Blades, Buffalo, N. Y.

HOBBIES, COLLECTIONS

RAILFANS—Send 25c now for current copy of Trains, excellently illustrated monthly magazine about railroads and railroad travel. Trains, 1572 W. Pierce, Milwaukee, Wis.

MAKE Novelties from sea shells. Enormous profits. 30 assorted prepaid $1.00. Novelty Shells, Box 3494, Jacksonville, Florida.

30 ASSORTED Decorative Decals, late patterns. 25c. Ira Decal, 745 S. Kostner, Chicago, Ill.

CIGAR-BAND Collections bought. Van Esen, Soundview Circle, White Plains, New York

TRADE-WINDS, a miniature newspaper about hobbies. Sample 5c. Calistoga, California

BEAUTIFUL assorted Jewelry Stones, (new) 200 for $2.00 postpaid. Moore's, 461 South State, Chicago

WANTED Old cigarette cards. Write Bray, 1127 Jackson, Easton, Pa.

HOME CRAFTSMEN

20 LAWN Ornament patterns 25c. Other patterns 15"-30" high, Dutch girl, Dutch boy, pirate, bull terrier, Mexican girl, Mexican boy, dwarf, penguin, flower girl, for each 3 for 25c. 25 Novelty patterns 20c. All 62 full size patterns $1.00 postpaid. Strother, Box 383-DC Bennington, N. Y.

NEW Pattern & Supply Catalog. Plywood Novelties, Lawn Ornaments, Silhouettes, Decal Transfers, Letters & Numerals, Patterns, Handy Hand Tools. New Power Sander. Other Lines. 500 articles finely illustrated. Write today. The Wo-Met Shop, Asheboro, Georgia

GET Free leathercraft instruction pamphlets, prices of leathers, tools, projects. Fascinating Hobby. Make gifts. Leather samples 5c. Wagner & Company, 1838 [illegible], Dept. A, Chicago, Ill.

LEATHERCRAFT Send 5c for catalogue showing designs that we emboss in leather objects. You assemble. Leather Project Company, Box 561 B, Detroit, Michigan

LEATHERCRAFTSMEN Send 10c for handbook and catalogue of tools and supplies. F. A. Sweet Co. Inc., Leathercraft Division 5-16, 146 State St., Binghamton, N. Y.

VENETIAN Blinds, supplies, machinery, wholesale. Catalog 10c. "Manufacturing Booklet" $1.00. "Roberts," Box 260, Gloversville N. Y.

STEERHIDE (unfinished) 10c and up sq. ft., scrap leather 2 lbs. $1.00. P. Nelson, 611 Pine St., Muskegon, Mich.

MEXICAN Novelties easily made. 20 patterns complete shell[illegible] 25c. Mexican Art [illegible]

[illegible] TEL-CHOW Plans. Explained. For home [illegible] of all ages. Classified list. [illegible] C. Kline, E. Kingston, N. H.

KNOCKDOWN Cedar Chest. Foreign and Domestic Veneers, Lumber. Catalog 10c. Olive Kendall Co., Decatur, Ala.

BUILD a cemented plywood kitchen cabinets. Plans 25c. Roger Underwood, 4617 Johnson Ave., Western Springs, Ill.

VENETIAN Blinds and Supplies. Literature Free. Homecraft Supply, Aurora, Ill.

INVENTIONS WANTED

WANTED immediately, ten practical inventions, patented or unpatented. Mail full details. Strictly confidential. Invention Service Company, Dept. B, Professional Arts Building, Hagerstown, Md

SIMPLE, practical inventions wanted by manufacturers, patented or unpatented. For information write Chartered Institute of American Inventors, Dept. 3-C, Washington D. C.

SMALL inventions wanted by manufacturers. I'll help you sell your invention. Write for free circular. S. Hull, 1829-M Euclid Ave., Cleveland Ohio

INVENTIONS Promoted. Patented or unpatented. Write Adam Fisher Co., 183-A Enright St. Louis Mo

CASH for Inventions—Patented, unpatented. Mr. Ball, BC-9441 Pleasant, Chicago

NOW, you can enjoy monthly, cash income from unpatented ideas. Postcard brings proposition. Henrichsen, Argyle, Wis.

LEGAL DIRECTORY

MEXICAN Legal matters, Wm. Cocke, Reliable Amer. Atty., El Paso, Texas.

MACHINERY, TOOLS & SUPPLIES

BUILD your own machine tools. Lewis furnishes semifinished castings for Bench Milling Machine and Shaper rough castings for 23 metal and woodworking tools. Shop-tested materials and professional blueprints. Never a complaint on quality, design or price! Send 10c. New 1942 32 page illustrated catalog. Lewis Machine Tool Co., Dept. S-12, Box 1-6, Station A, Los Angeles.

DRILL Grinding attachment, price $8 25, used with bench grinder. Literature on request. Tractor-Lite Co., Sidney, Iowa.

MAGIC TRICKS, PUZZLES, JOKER NOVELTIES

TRICKS you can do! For Pocket, Parlor, Stage. With coins, cards, cigarettes, ropes, balls, thimbles, apparatus. Magical books, illusions. Send 10c for latest 100 page Catalog of 500 Tricks which includes Free 10 selected Pocket Tricks. Send 10c today. Douglas Magicland, Dallas, Texas.

HOUSE of 1000 Mysteries! Famous coast to coast! Professional Magic! Tricks! Joker's Novelties! Two big catalogs combined into one Giant Edition! 600 Illustrations! Only 10c. Vick Lawston, Dept. F-71, Queens Village, N. Y.

WORLD'S largest professional magic shop keeps you in touch with latest tricks. To receive mailings send 25c for 1942 catalog. Holdens F-220 W 42nd St. New York.

MAGICIANS. Gamblers secrets exposed. Cards, Dice, Punchboards, Slot Machine. Catalog 10c. Book Co., Box 671, St. Louis, Mo.

MAGNET tricks—3500 word instruction booklet and two 1" Alnico bar magnets—they float all for 75c. Circulars, 5c. Terry Sales, Central Station 1676, Toledo, Ohio.

HOLLYWOOD Special. Magicians big catalog, ghost illusion and free trick for 25c. Magic House of Charles, Box 6086, Hollywood, Calif.

"TAPADINK"—new pocket mental mystery, ten cents. Mirlandon Magic, 4-8 East 35th, Tulsa, Oklahoma.

BE A Magician. Large professional magic catalogue of latest tricks, 25c. Ireland, F-109 North Dearborn, Chicago.

FREE Trick and Professional Magic Catalogue 25c. St. Louis Magic Studio, 418 Olive St. Louis.

CIGARETTE Vanisher or trick pack of cards. Free with catalog, 25c. Elton, 4467 G Germantown, Philadelphia.

JOIN Magicians Fraternity. Free Tricks! Monthly Magazine sample 10c. International Magicians, Mount Morris, Ill.

MAGICIAN'S Headquarters 216-page illustrated catalog 25c. Kanter's, 6-1311 Walnut, Philadelphia.

MAGIC Tricks! New 180 Page Catalog—25c. Chicago Magic Co., 2300 Mason, Chicago.

MAGIC. Novelty catalog, three gifts, 10c. Frank Wencel, Hamtramck, Mich.

MANUFACTURING

MANUFACTURING any material, any quantity. Inventions developed. Mirtrron, Burlington, Ky.

MINERALS & PRECIOUS STONES

GEMS Agate Mountain Jewelry Box rough gemstones. Emerald, Sapphire, Garnet, Topaz, Firopo, Agate $1.00 postpaid. Catalog. Hill Co. Route 7 K. Salem, Oregon.

CHINESE carvings in Jade and other stones. Fernquist, N 4106 Walnut, Spokane, Washington.

MISCELLANEOUS

DISCOVER Your Hidden Powers. Ontology can solve your problems, promote harmony, friends, success, health, security. Answer prayer. Open the Bible. Particulars free. Alexander Keene, D-451 South State, Chicago.

DEAFNESS. Why? Good hearing without mechanical aids. No drugs. Relieving deafness. Johnston, Sta. C. Vancouver, Canada.

DRUG Sundries, specialties, supplies, etc. mailed directly by manufacturer. Send for free mail-order catalog, saving 75%. Mail-Order, Dept. 4A. Box 331, Hamilton, Ontario.

REPRODUCTIONS of Masterpieces each 4"x5". 12 assorted pictures for 25c. S. Greaves, Pilgrim Terrace, Poughkeepsie, N Y.

"1942 Press Cards"—"Tags"—Press Supplies, 1934 Eleventh, Washington, D. C.

SCIENTIFICALLY constructed Black Walnut Cracker, $3.50 prepaid. Money back guarantee. Clarke Nuts Co. Harrisburg, Pa.

HEATING six room house $20.00 yearly. Information 10c. Rosenzweig, R. R. 10B3, Cincinnati.

PEN and Ink sketches from photographs $1.00. Particulars free. Louis Maduzia, 3715 S. Honore St., Chicago, Ill.

BEAUTIFUL Mexican Cactus Plants, 25 varieties, $1.50. Special Products, Laredo, Texas.

RECEIVE gigantic Mail Magazines sample. Your name in numerous mailing lists 10c. Howard, 396 Broadway, New York.

FREE literature how to locate buried treasure and minerals. Fisher Laboratory, Palo Alto, Calif.

DRESSES 10c. Shoes 30c. Coats 75c. Hats 10c. Free Catalogue. Crown, 164-PS Monroe St. New York.

CHEER-UP Calendar, Humorous daily poem. $1.00. Margaret Drew, Devils Lake, N Dak.

MEXICAN feather pictures 35c, framed 70c. Live chameleon 25c. Free catalogue. Quivira Specialties, Winfield, Kansas.

CORRESPOND. Five names, addresses of your name address sent five times. 25c. Raymond Monat, Louisville, Ohio.

FREE Catalogue of Used Clothing Bargains. Dresses 9c, Men's Coats $1 up. Dept. PO, Liberty, Station B, Box 81, N. Y. C.

MODELS & MODEL SUPPLIES

SAVE Money—get quick service direct by mail. Every Model Railroader should have our big new 36 page 1942 catalog before purchasing. Catalog ten cents. Model Railroad Shop, Dept. PS, Dunellen, New Jersey.

BUILD a model railroad. Best plans and construction articles are in Model Railroader Magazine. Send 25c now for current copy. Model Railroader, 1343 W. Pierce, Milwaukee, Wis.

LEARN to enjoy your spare time. Get the greatest Scale Model Railroad Data Book ever published. Act quickly and send 10c to Scale Craft & Co., Libertyville, Ill. Dept. P S.

POWER Models. Railways, traction engine, steam and gasoline engines, all accessories, castings. Fresh 34 page catalog 25c. Charles Cole, Ventura, Calif.

MOST complete illustrated Catalog—O-HO OO Model Railroad Parts ever published. Send 5c for mailing. Selle, 1377 Gates Ave. Dept. 801, Brooklyn, N Y.

SPEEDBOAT 20x7" completely prefabricated kit. Mahogany trim. Propeller, tube, rudder, plans and instructions $3.95 postpaid. Bertrand, Berwyn, Md.

SHIP Model and yacht supplies, complete large 56 page Catalogue 15c. Wm. Wild, 510 E. 11th St. New York City.

IMMENSE Mini Train railroad catalog! 62 pages. Send 25c. Vanden Boom's, 2437 Broadway, Kansas City, Mo.

MODELMAKER'S Knife, extra keen. Ebony cut blade handle 60c postpaid. Bertrand, Berwyn, Md.

SCALE Model Airplane and Railroad Kits. Circulars Free. Hobbycraft, 2209 E. 75th, Chicago.

TRAINS O Catalog 25c. HO 10c. Walthers, 269 Erie, Milwaukee.

MODEL racing Cars. Three Plans 25c. Northern Aircraft, Manitowoc, Wis.

MODEL Airplane Kit, 25c. Idle Hour Hobby Service, Shillington, Pa.

MONEY MAKING OPPORTUNITIES

PROGRESSIVE Mailtrade, published monthly—44 pages—offering latest mail-order projects, services, business starters. Copy 10c. Publishers, Box 116-D, Gardenville, New York.

CO-PUBLISHERS Wanted. Reliable matrimonial tabloid. Unlimited profit possibilities. Sample copy, details, free. Syndicate Manager, Box 2501, Vanderveer, Brooklyn, New York.

BE a professional scrapbooker. Big fees. Unlimited opportunities. Can be done at home. No competition. No capital needed. Write to Scrapbookers Guild, 63 Park Place, New York, N Y.

BE A Metascientist. Remarkable drugless healing system. No manipulation, no apparatus. Inexpensive correspondence course. Free information. Metascience, DeLand, Florida.

AMAZING New 15-Way Profit Mail Order Business Plan. Few Dollars starts. Details, Write Bradley's, Box 10718, Raleigh, N. C.

REFINE old crankcase oil. Also simple way to convert into fuel oil. Each 59c. Both $1.00. Wayne Engineering, Dept. 10, Greenville, Ohio.

YOU'LL Like Resilvering Mirrors, Tableware, making Chipped Glass Nameplates, Signs. Outfit prices. Sprinkle, Plater, 930, Marion, Indiana.

YOUR name on 5,000 mailing lists—25c. Get free samples, opportunities, galore from all over world. Eastern, 3-961 46th, Brooklyn, N Y.

LEARN to write fillers, short articles, gags. Folio of proved information markets. $1.00. Richard Publishing Co., 4360 Maple, Dallas, Texas.

10 DOLLARS Daily. Assures your independence. A marvelous discovery. Information 25c (not a fraud). F P Benson, Desert Lane, Creve Coeur, Missouri.

300 TESTED Moneymakers, 64-page book, 40,000 words. Business secrets, formulas, wholesale supply sources galore. 25c. Scotts, Box 342, Covington, Ky.

EARN Money taking magazine subscriptions. New York Circulation, 30 Church, New York.

WOMEN. Make money at home. 100 splendid plans, no formulas! 64 pages, postpaid 25c. Clever Ideas, Ashburn, Georgia.

BIG Mail and Opportunities. Send 15c. F. R. Clark, Route 1, Hagaman, New York.

OPPORTUNITIES Galore, giant mails 10c, sample mailing free. Harvey Toombs, CP5, Decatur, Ind.

MOULDS to cast Lead Soldiers. Send 5c for big catalogue. Hendrick Schlercke, Ghent, N Y.

EARN money evenings, copying, duplicating cartoons for advertisers. Ad-service, Argyle, Wis.

FIVE Amazing moneymaking plans 25c (coin). Rex Devaney, Gainesville, Texas.

MONUMENTS

MONUMENTS—Direct Low Prices. Freight paid. Guaranteed. Free Catalog and samples. Write Granite-Marble Factory, A40, Oneco, Florida.

MOTION PICTURE & SOUND EQUIPMENT

8-16-35MM Films. Bought—Sold—Exchanged. Silent-Sound $2 up. Odd reels $1.50. 1000 feet 35MM, 95c. Arts-Catalogue. Sample film, 10c. International, 2120 Strauss, Brooklyn, N Y.

MOVIE Film 100' 16mm $1.50, nonhalation $1.30, Weston 100 $1.95. 25' double 8mm, 95c. Processing included. Also bulk film. Ambassador, 476-A Quincy St. Brooklyn, N. Y.

NEW Film exchange plan and catalog of movie equipment. Paramount Mfg. Company, Dept. M 30, Box 234, Back Bay, Boston, Mass.

COLOR for Christmas! Exciting films, all types. Lists, sample film in color 10c. Cine-Art, 1533 N. Mariposa, Hollywood, California.

NATIONALLY advertised movie cameras, projectors, films. Cash or terms. Free catalogues. Don Elder's, 6-739 Boylston Street, Boston, Mass.

DEVELOP your own movies. Complete, illustrated instructions 15c. Cine Laboratories, 1628 New York Ave., Brooklyn, N Y.

8-16MM Films silent-sound, bought, sold, exchanged. Films rented everywhere. Free catalogue (with sample art 10c). Garden Film, 317 West 50th, New York.

8-16MM Art films. Free catalogue (sample 10c). Parkway Exchange, 961 Eastern Parkway, Brooklyn, New York.

FREE List, movie equipment and films, lowest prices. Peters, Dept. F, 41 S Fourth St., Allentown, Pa.

LEARN Motion Picture projection, management. Free Catalog. Give age. Theatre Institute, 375 Washington, Elmira, N. Y.

AMAZING Hollywood Productions. Sample Scene, 16 Dimes. Kreiner's Laboratories, Allentown, Pa.

SAVE 50% on movies. Bargain circulars. Geneta Co. Davenport, Iowa.

MOVIES for grownups. Not arts. Lists, lens cloth, 10c. Jenkins, 392, Elmira, N. Y.

THE End trailers—8mm. 3 for 25c. Gilbert, Box 6185, Cleveland, Ohio.

ART Subjects (Catalogue-Sample 10c) Midwest Cine Shop, Hannibal, Missouri.

MOVIES. 1942 List Free! Samples 10c. Goodwill Company, Jackson, Tenn.

MOTORCYCLES, BICYCLES & SUPPLIES

MOTORCYCLE parts, accessories. Most complete stock. New & used. We specialize on Mail orders. What do you need? 32 page catalog 10c. Whitman Motorcycle & Supply Co., 440-B Southwest Blvd., Kansas City, Mo.

MOTORCYCLES reconditioned. New used, parts and accessories. All makes. Large stock. Bargains. Illustrated catalog [illegible] Indian Motorcycle Sales, Kansas City, Mo.

PISTONS—and Parts. New and Used, all models. Catalogue and Wings Pin 10c. Banks, 811 N. 8th, St. Louis, Mo.

MUSIC, MUSICAL INSTRUMENTS

MUSIC composed to words. Rhyming pamphlet on request. Phonograph recording of completed song. Send poem. Keenan's Studios, Dept. PS, Box 2140, Bridgeport, Conn.

LEARN Swing piano! Postal brings free folder. Christensen, 463 Kimball Hall, Chicago.

SONG Poems wanted. Free examination. McNeil, Master of Music, 510-PS South Alexandria, Los Angeles, Calif.

PHONOGRAPH Records 10c. Free list. Hoodwin Company, Dept. PS, 4419 Broadway, Chicago.

WANTED! Lyrics, melodies for songs. We arrange, publish, sell. Superior Song Studios, Passaic, N. J.

MUSICAL Shorthand—For Composers, Arrangers, Song Writers 50c. Musical Shorthand, Wheeling, W. Va.

PHONOGRAPH Records 10c. Catalogue. Paramount MU 358 East Market, Wilkes-Barre, Penna.

PIANO By ear. Free booklet. Write Day-V-Way, Dept. S-B, Dearborn, Mich.

OLD GOLD, WATCHES, PRECIOUS STONES

GOLD $35.00 Ounce—Mail old gold teeth, diamonds, jewelry, watches—receive cash by return mail. Satisfaction guaranteed. Free information. Dr. Weisberg's Gold Refining Co., 1500 B Hennepin, Minneapolis, Minn.

WANTED! Gold, silver, platinum, diamonds, mercury, etc. [illegible] Simon's Jewelry, 353 Old Arcade, Cleveland, Ohio.

OLD STAMPS WANTED

I WILL pay $ 00.00 each for 1924 1c green Franklin stamps, rotary perforated eleven (up to $1,000.00 each unused). Send 6c today for large illustrated folder showing amazing prices paid. Vernon Baker, (21-PS), [illegible], Ohio.

PATENT ATTORNEYS

INVENTORS: Take first step toward protecting your invention—without obligation. Write for Free "Record of Invention" form for establishing date of invention. We Also send Free 48 Page Book "Patent Guide for the Inventor" telling importance of prompt action, considerations, search service, how to sell and market invention, details of convenient payment plan. Send for free "Patent Guide" and "Record of Invention" form today. Clarence A. O'Brien, Registered Patent Attorney, 328-A Adams Building, Washington, D. C.

INVENTORS: Write immediately for two free books, "Patent Protection" and "Selling an Invention." Explain many interesting points to inventors. Evidence of Invention form enclosed. Reasonable fees, forty four years experience. Avoid risk of delay. Address Victor J. Evans & Co., Registered Patent Attorneys, 441-A Victor Building, Washington, D. C.

INVENTORS: Before disclosing your invention to anyone send for Form "Evidence of Conception." Schedule of Government and Attorneys Fees and Instructions. Sent free. Lancaster, Allwine & Rommel, 413 Bowen Building, Washington, D. C.

MANY inventors will be interested in our service. Information on subject of obtaining a patent and marketing an invention supplied without charge. We are personally McMorrow & Berman, Registered Patent Attorneys, 1633 Barrister Bldg., Washington, D. C.

PATENTS. Trade marks. Preliminary advice book and disclosure form free. Personal service. Irving L. McCathran, 116 McLachlen Bank Bldg., Washington, D. C., Registered Patent Attorney.

INVENTORS: Send for free copy my 72-page book on patents. Reasonable terms. Prompt action. Confidential, personal service. L. F. Randolph, Dept. 340-A, Washington, D. C.

PATENTS—Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 724 Ninth St., Washington, D. C.

"INVENTOR'S Guide" free, full information about patenting, selling inventions. Frank B. Ledermann, 154 Nassau St., New York.

"PATENT-Particulars" and Blanks, free, airmailed. Sterling Buck, F-Hotel Plaza, Washington, D. C.

PATENTS

WE Successfully sell inventions, patented and unpatented. Write us, if you have a practical useful idea for sale. Chartered Institute of American Inventors, Dept. 3-B, Washington, D. C.

PATENTS FOR SALE

TWO Inventions easily manufactured, existing demand. Chas. Gardner, Pleasant Grove, Calif.

PLANTERS [illegible] No. 2,270,116. T. Passanen, Franklin Mine, Mich.

PERSONAL

SEND $1 for formula for an ideal laxative from fruits. Six months [illegible] supply made in thirty minutes, at small cost. A good food. Children like it. Take fruits instead of drugs and feel better and happier. Tested over twenty years. Money returned if not satisfied. Grandma's Fruit Laxative, [illegible] West Olympic Blvd., Los Angeles, California.

IMPROVE your character, employment, popularity. Understand the lines on your hand. Distinguished hand analist tells you how. $1.00 brings complete Formula. Charts, Instructions. Box 567, Studio City, Calif.

PSORIASIS Sufferers. Pixacol has brought results when everything else failed. Applied externally, dries quickly, convenient. Try regular $1 bottle without investing a cent! Write: Pixacol Co., Box 3583, Cleveland, Ohio.

FOOT sufferers — Arch supports made from your feet impression. Amazing Relief $1.50 pair. Guaranteed. Send for impression material. Nu-Feet Co., 1472 Broadway, N. Y.

WIN prize money. Booklet, Successful Contesting, shows how. 10c postpaid. [illegible] included. World Publishers, 4416-L Cottage Grove, Chicago.

COUGHING? Chest colds? Bronchial? Quick pleasant Relief. Make your own Remedy. Famous [illegible] Recipe easily prepared. Big Savings. Free particulars. Trable, 606 Irving Park, Chicago.

DOMESTIC and matrimonial problems, confidentially helpfully answered. Send one dollar, stamped addressed envelope. [illegible] Betty Jane, Dept. M, 236 N. [illegible], Columbus, Ohio.

GET prompt quicker relief from Burns and Scalds with Burn Aid. Send now 10c [illegible] for sample and free literature. Emelas, Montclair, New Jersey.

NEW posture-corrective device that helps relieve backache [illegible] tired feet, headache. Free details. Write Posture-Aid, Dept. P, 500 Centre, Dallas, Texas.

HARMONY Centre, 404 W. 112th St., New York. The Grape Cure, Johanna Brandt. Famous book on the value of grapes. Cloth $2.00, paper $1.50. Health literature.

SINUS Trouble. If a victim of Sinus or Catarrhal infection write National Laboratories, Benj. Franklin Station, Washington, D. C.

NERVOUS? Conquer fear, worry, bashfulness! Free, special information. John Englund, Box 335A, Ironwood, Mich.

LOOSE False teeth relined at home easy way. Makes Plate Fit Snug. Write for information. Dr. C. N. Reese, Glencoe, Ill.

FOOT Sufferers—Send for Free Arch Support Impression Material. Blair Company, 4520 Sheridan Road, Chicago.

LOWEST prices blades. Aprils, X-cellos, Silvertex, Texide, many others. Free details. Star Products, Buffalo, N. Y.

100 PSYCHOANALYTIC questions 10c. Analysis $1.00. [illegible] Associates, 16 Depot Square, Englewood, N. J.

JOIN U. S. Rocket Society. Information, dime. 4106-501 N. Kenmore, Chicago.

GIRLS Win Happiness. 25c for information. [illegible] Massillon, Ohio.

PHOTO FINISHING

FREE—2 Enlargements with each [illegible] roll developed and printed 25c. Albright Studios, 1208 Edwards St., Omaha, Nebraska.

IMMEDIATE Service! Pictures returned same day order is received. Sixteen guaranteed Deckled Edge Velox Prints from roll 25c. One colored or two plain enlargements plus 8 Deckled Edge Velox prints 25c. Special! Coupon for 5x10 enlargement given with each 25c order. Any 36 exposure 35mm fine grain developed. Magic Eye timed Vaporate Treated and each good negative enlarged to 3x4 on Deckled Edge Velox paper only $1.00. Reloads 36 exposure 50c. 18 exposure 35c. 3x4 Deckled Edge reprints 3c each! Details, sample mailers, other bargains free on request. American Studios, Box 71, La-Crosse, Wis.

35mm ARGUS Leica, etc. (except "Mercury") 36 exposure rolls, fine grain developed, Eastman DK 20, and beautifully enlarged to 3" x 4" glossy prints, 90c. Cartridges reloaded with Eastman Plus X, 35c. 18 exposure rolls, 60c, reload 30c. Films permanently protected by revolutionary [illegible] Process. 24-hour service. Satisfaction guaranteed. Free mailing bags, sample print. Write Technichrom Laboratory, 44, 643 Brown St., Dept. 11, Rochester, N. Y.

DOUBLESIZE Prints. Your roll developed and 8 doublesize prints 25c, from 116, 120, or 127 size negatives you receive 4x6 inch prints. All smaller sizes receive 3¼x4½ inch prints. 16 exposure rolls 50c; 12 exposure rolls 35c. Reprints 3c each. Our Guarantee. Everlasting Hi-gloss Finish. Overnight service. Pacific Photo Service, Box 666, San Francisco, Calif.

BIGGEST $1.00 value in 35MM finishing today! 36 exposure fine grain vaporated [illegible] enlargements, deckled embossed margin and date. Eighteen exposures 75c. Sixteen exposure splits 55c. Free mailers. 8 exposure rolls in beautiful, deckled contact finish with free handy album 25c. Mailbag Film Service, Box 5440A, Chicago.

FOR the discriminating amateur—8 exposure rolls, 2 prints each 25c. Miniature rolls enlarged 3 to 4 times. 8 exposures 25c, 16 exposures 50c, 35MM 36 exposures, 3x4 enlargements $1.00. Unexcelled quality, prompt service. Paramount Photo, 1683-1st Avenue, New York.

FREE To Popular Science Readers. Any [illegible] developed to [illegible] Nu Art [illegible] enameled prints plus two beautiful [illegible] enlargements and two Free [illegible] frames. Only 25c; 20 reprints, 25c; 100, $1.00. Overnight service. Nu-Art, F-27, Des Moines, Ia.

FINER Finishing Specials. 25c. 8 exposure roll developed, your choice 2 prints of each or 1 enlarged print of each negative on Genuine Nationally known [illegible] [illegible] paper quality. Moen Photo Service, 200 Moen Bldg., La Crosse, Wis.

OIL coloring photographs a fascinating hobby or profitable business. Learn at home. Easy simplified method. Previous experience unnecessary. Send for free information and requirements. National Art School, 1315 Michigan, Dept. 1721, Chicago.

PHOTOSTAMPS: perfect copies of your favorite photograph (returned unharmed); stamp size, gummed, perforated. 25 for 50c. Ideal Photo Studio, Box 366AB, Pauls Valley, Oklahoma.

PHOTOGRAPHY for pleasure and profit. Prepare at home. Common school education sufficient. Write for information and requirements. American School of Photography, 1315 Michigan, Dept. 1722, Chicago.

FREE Book—"Secrets of Taking Better Pictures" with each order! Kodak roll developed plus 16 super-gloss, neverfade prints, all 25c. Superlabs, Dept. 506-S, Elroy, Wis.

ROLL Developed, 8 5x7 large prints 30c. Return Mail service. Camera bargains. [illegible] $8.00. Argus A $4.00. A2F $6.00. Others. Abbey Camera Shop, 6cA, St. Louis, Mo.

LIFE LIKE 5x7 Colored and Framed Enlargement from your favorite negative or photo, only 50c plus postage C.O.D. Order Now. You'll be delighted! Mosher [illegible], Vineyard Haven, Mass.

ROLLS developed and two oversize glossy Velox prints, 8 exposure 25c, 12 exposure 45c, 16 exposure 60c. Overnight service. Comet Photo Service, 1316 W. Columbia Ave., Philadelphia, Pa.

ROLLS developed, two prints each and two free enlargement coupons, 25c; reprints, 2c each; 100 or more, 1c. Summers' Studio, Unionville, Mo.

IDEAL Photos beautifully finished wide border deckle edge 25c, roll of 8 and free enlargement. Ideal Photos, Box 2264, Paterson, N. J.

TWO beautiful prints from each picture on roll 25c. Twenty years of satisfied customers. Quick Service. Lens Photos, Dept. J-8, Janesville, Wis.

ROLL Developed, 16 fadeless prints, 25c coin. Enlargements 8x10 and smaller 25c, 5 for $1.00. Hayes, Box 1034, Jacksonville, Fla

ROLL Developed, 8 brilliant fadeproof Velox prints and two professional enlargements 25c. Overnight service. Young Photo Service, 408-C, Albany, N Y

ONE day service. Roll developed, 8 Velox prints, 2 double weight enlargements or 16 Velox prints, 25c. Photo Mart, Dept. B, Milford Conn

ROLL Developed—16 guaranteed prints, two coupons on enlargements, 25c Smart Photo, Winona, Minn

20 REPRINTS 25c, 100—$1.00. Roll developed 16 prints 25c. 5x7 enlargements 10c, 3—25c. Nordskog, 88, Maywood, Ill.

PROMPT Service! Roll developed, two prints each negative 25c. Hench Studios, Harrisburg Pa

ROLL Developed, eight post-card size enlargements 25c [illegible] Photo [illegible] N Y

16 OVERSIZE Deckledged prints and two enlargements, 25c Owlphoto P52, Weatherford Okla

3 BEAUTIFUL 5x7 enlargements from negative 25c Photos [illegible] Ohio

ROLL developed three enlargements, 16 prints, 25c. Dick's Photo, Louisville Ky

POULTRY & SUPPLIES

RAISE Turkeys For Profit Learn latest methods brooding feeding management growing dressing marketing. Read oldest best turkey magazine. One year $1.00 five months, 50c. Turkey World, Desk 710, Mount Morris, Ill

NATURAL Color Poultry Pictures, valuable ideas, successful management methods in leading poultry magazine help you increase poultry profits. Five years $1.00 one year 25c, Poultry Tribune, Dept. C-38 Mount Morris, Ill.

LOW Factory prices on Poultry Equipment Wire fabrics. Free 100-page catalog Bussey Pen Products, 5170 West 65th St., Chicago

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, LABELS

100 BOND 8½ x 11 Letterheads and 100 Envelopes $1.00 Refund [illegible] West Roosevelt Philadelphia

1000 BUSINESS Cards [illegible] Letterheads $1.75 1000 Envelopes $1.95 Standard Printing, Fairmont, West Va

QUALITY Printing at bargain prices Samples. Write Publishers, Dept. L, Harbor Springs, Mich.

PICTURE Labels 500 [illegible] 10c Refundable [illegible] PS 142, Waterbury Conn

HAMMERMILL Letterheads envelopes all colors, 32 [illegible] type Free [illegible] Woodruffe [illegible] Duluth Minn

JOB Printing Quick reasonable Samples Atlantic Box 851 R Rock Hill S C

500 3x4 ATTRACTIVE parcel post labels $1.00. Colorpress, 3025 Temple, Detroit

PRINTING OUTFITS & SUPPLIES

PRINT your own cards, stationery, circulars, advertising. Save money. Simple rules furnished. Print for others, nice profit. Junior outfit $8.25 Senior outfit $18.50. Details free. Kelsey Inc., T-8, Meriden, Conn.

PRINT at home. 10c will bring a complete catalog of presses, type and supplies. P Peiffer & Company, 6 Columbia St., Newark N. J

PRESSES, Bargain Supply Catalog Send stamp. Bradshaw, 3716-W Huron, Chicago

BARGAINS, Presses, type. List 3c Exchange, 190B Cook. Meriden. Conn.

PRINTING Presses, Type, Supplies. Lists 3c. Turnbaugh Service, Loysville, Pa.

INEXPENSIVE 6x9 Printing Press. Details Free. Novelty Shop. Downsville. La

NEW Type 75c font Catalog dime Box 123Z, Jackson, Michigan

PROFITABLE OCCUPATIONS

ANNOUNCING new home study course in commercial baking. Good field. Nearly depression proof. Common school education sufficient. Send for free booklet "Opportunities in the Baking Industry" and requirements. National Baking Institute, 1315 Michigan, Dept 1721, Chicago.

$40.00 WEEKLY, made growing mushrooms for us, fresh, dried. Dominion Patent 331583, free spawn. North American, 109Y Yonge, Toronto, Canada

$5000 FROM half acre. Growing ginseng. Seed, contract supplied. Crop bought. Particulars 10 cents. Associated Growers, Dept 12, St Norbert Manitoba.

RADIOS, SUPPLIES & INSTRUCTION

RADIO engineering broadcasting, aviation and police radio, servicing. Marine and Morse telegraphy taught thoroughly. All expenses low. Catalog free. Dodge Institute Poplar St Valparaiso, Ind

MAKE Simple Long Distance Crystal Radios. No tubes, batteries & per [illegible] Meeting Crystal and illustrated instructions 25c Allen [illegible] Mo

REVISED plans 10 Crystal Sets 15W record 4800 miles [illegible] Radiobuilder year 25c Laboratories, 1606-T 77th Avenue Oakland, Calif

BEGINNERS—12 crystal—tube radio plans 25c Gilbert Box 4 85 Cleveland Ohio

SAMPLE Radio Lesson, free. Supreme Publications, 328 South Jefferson, Chicago.

RARE COINS

FREE! Foreign Coin, banknote and large 30 page illustrated coin catalogue to approval service applicants. Send 3c postage. Up to $20 cash paid for Indian head cents. All coins wanted Buying list 10c Tatham Coinco Springfield D50, Mass

WE buy Indian cents, Lincoln cents and old money. Send 10c today for advanced catalogue of prices we pay for all Wanted U.S. coins. American Rare Coin Co., Dept. 4, Transportation Bldg. Chicago

WILL Pay $15.00 Each for Certain Lincoln Pennies! Indianheads $100.00 Dimes $1,000.00 All rare coins wanted. Illustrated catalogue 10c Federal Coin Exchange, [illegible] Columbus Ohio

COMMEMORATIVE 50c. Columbian, Lincoln, Stone Mountain, Long-Island, Cleveland, $1.00 each Illustrated catalogue 25c Norm Shultz. Salt Lake. Utah.

PRICE List of U. S. Coins Bills and Accessories. 10c 75 Illustrations, 2500 Quotations. James Randall, 341 S. Dearborn, Chicago

WE purchase all Indianhead pennies. Purchasing catalogue 10c. Greenwood, 108 Broadway New York

10 DIFFERENT Indianhead Cents and price list 25c Wholesale PS-361 South Sandusky Columbus Ohio

8 DIFFERENT Indian head cents. 25 cents. Bishoff, 414 E. 8th. Kansas City, Mo.

RUBBER STAMPS

CUSHIONED, 2 lines 25c 3—35c. Ours are better! Ad-Crafts, LaCrosse Wis

BEST Quality 3 lines 35c Federich Company, B413 M East Pittsburgh Pa

3 LINES 25c Indexed 35c Signatures $1.50 Printrite Wauwatosa, Wis

SONGWRITERS

WANTED Poems to be set to music. Submit for consideration. Transcription records made. Rhyming Pamphlet Free. Keenan's Studio. PS, Box 2140, Bridgeport, Conn

SONG Hits Song Poems Wanted. Free recording if accepted. Write for Free DeLuxe Rhymer DeLuxe Music Service, Box 2163 R, Bridgeport, Conn

SONGS Song Poems Wanted. No Charge for melodies. Free examination. Hollywood Recording Studios, 87L13 Preuss Sta. Los Angeles

SONG Writer Course shows how $1.00 Song Bureau, Box 1997-P, Washington, D. C

SONGWRITERS! Submit poems for offer. Five Star Music Masters, 646 Beacon Bldg., Boston

SONGWRITERS wanted. Work guaranteed. Publication. Greateastern Songbureau. 42PSI, Thomaston, Maine

SONG poems wanted for musical setting. Free booklet. Write today. Song Service, 41-J Park Place, Brooklyn N Y

MUSIC Composed, song printed, recorded Reginald Weber, Chatham, New Jersey. Established 1910

SONG Poems wanted. Free examination McNeil Master of Music 510-PS South Alexandria Los Angeles Calif

SONGWRITERS Write for free booklet, profit sharing plan. Allied Music Company 7608 Reading Cincinnati Ohio

SONGWRITERS—Write for Free Book—Send Song Poems, Variety Salem, Indiana

SONGWRITERS Send poem for our plan and Free Rhyming Dictionary. Richard Brothers. 146 Woods Bldg Chicago.

SONGWRITERS! Words, melodies. Amazing offer. Hibbeler, C-15, 2157 No. Avers, Chicago.

SPORTING GOODS, GUNS, FISHING TACKLE, ARCHERY

BOOMERANGS as Gifts! We have the largest assortment of boomerangs in the World. Free folder. Mer Sporting Goods Co., Chrysler Bldg., N Y

HUNTING, trapping, camping equipment. Used guns. Catalog. Howe, Coopers Mills, Maine

BEAUTIFUL Hunting Blowing Horns high tone 14" $2.00 18" $3.00 E G Cavazos, Laredo Texas

ARCHERY equipment catalogue free Mid-West Archery, 2208-D East 75th, Chicago

STAMP COLLECTING

NOTICE

Readers answering ads offering *Approvals* receive a selection of stamps from which they may make purchases at prices indicated. Ten days are allowed for payment and return of undesired stamps. Otherwise approval applicants become subject to Section 2550, Postal Laws & Regulations, 1932, providing penalties for obtaining property by false pretense.

15 PAN AMERICAN Sets 10c. To attract approval applicants of the better type we are making the following amazing offer. From our good neighbours in the Western Hemisphere 15 sets from 15 countries. Mexico 728 31 complete, Canada Royal Visit complete, Puerto Rico 85 86, Barbados 186 87, Newfoundland 3 values, Colombia RA1 4, Bolivia Fawn 3 values, Peru map and Pictorial, Guatemala 2 3, etc 3 values, Brazil 8 values, Chile 199-201, Paraguay commemoratives 2 values, Ecuador RA41 complete, Cuba 1917 3 values, Jamaica 3 values. We will send all these for only 10c to sincere approval applicants. Kindly state whether you wish On Approval United States, foreign or both. Approval Headquarters Globus Stamp Company, 268 4th Ave., New York City, Dept 217

FREE—Joseph Stalin Issue with $4.22 Collection for 10c! The only stamp picturing Stalin appears on the Soviet North Pole Issue. It's Free to new applicants requesting approvals with 138 Different spectacular 20th Century Issues as Albania's Zog, Czech's complete Independence, Switzerland landscapes, [illegible] Ukrainian Heroes, Polish Belvedere, Famous Hungarian, Rumania Soviet Mints, French Peace, Germany's Second and Third Reich and many other Best Sellers—Only 10c. Intercity Co Dept Y Port Washington N Y

GIANT Packet 130 All Different from Africa, South America, South Sea Islands etc. Includes Nicaragua (small two scarce unused United States cataloging 20c triangle and animal stamps, many others. Also includes fine collection 35 different British Colonies—Charkari, Jamaica, Johore etc and United States $4 and $5 high values. Total catalog price over $4.00! Everything for only 5c to approval applicants! Mystic Stamp Co Dept 46-A, Camden New York

STAMP Collectors outfit which everyone can use. It contains a Stamp Wallet worth 10c, 1,000 Peelable Stamp hinges worth 5c, 25 sheets for duplicates worth 10c, newest style Perforation Gauge worth 10c, efficiency Watermark Detector worth 10c, 10 Glassine envelopes worth 5c. Purchased separately you'd have to spend 60c, and in addition we will include a valuable mint collection of 30 diff Russia all for only 10c to new Approval Applicants Frasek Co., Dept. 106, White Plains, N. Y.

SUPER Wonder Packet offered containing stamps from Afghanistan (oblong) Tranquebar (small) North Borneo (buffalo) Manchukuo (Mausoleum) Sudan (native) Sarawak (rajah) Guadeloupe (sugar refining) Costa Rica (triangle) Iraq (late king) Brunei (boating) this entire packet for only 5c to approval applicants. Big illustrated lists free. Kent Stamp Co. G P O. Box 87 (24), Brooklyn, N Y

POSITIVELY Greatest Free offer—Latest Scott's International $4.00 Stamp Album—covering entire World contains 34,000 illustrated, descriptive spaces Scott's 1942 Standard $3.00 Catalogue "Philately's Encyclopedia"—absolutely Free to applicants for Foreign Approvals becoming customers. Plymouth, Dept A-1, Bell, California.

FREE! Unmatchable World Collection containing desirable British Colonial Commemorative issue complete. Valuable South American set exposing colorful natural resources. Bi-colored pictorial issue from mysterious Indian Ocean Island. Rampant Lion of Bohemia issue plus 100 different stamps, many from subjugated European Countries, only 3c to approval applicants. Friendly Philatelists, Box 44288, Philadelphia, Pa.

500 UNITED States for 10c! 500 U.S.A.—absolutely unpicked and unsorted—just as received from church Missions. Many varieties including commemoratives, airmails, high values up to $5.00 denomination! Price only 10c to approval applicants! Money back if not delighted. Swan Stamp Co., Dept. 60A, Dunkirk, N. Y.

60 DIFF. Mint Geo. VI Coronation pusler stamps plus scarce Cayman Is., Leeward Is., Turks and Caicos, etc. 3c to approval service applicants. Tatham Stamp & Coin Co., Springfield-36, Mass.

SURINAME, Transvaal, Venezuela, Newfoundland, Tanganyika, Tasmania, Wurttemberg, Herzegovina, Travancore, Dutch Indies, Siberia, Mongolia, Barbados, Rhodesia; Queensland. Everything 5c. Imperial, 30-P Inwood Station, New York City.

UNITED States approvals complete coverage fine quality, attractive prices. Seminole Stamps, Box 636, Coconut Grove, Florida.

WORLD'S Smallest Airmail—Diamond and Triangle Stamps. Free Stamp Magazine, also magnifier to study your stamps, with large collection of stamps from scarce countries. A Bargain, 3c with approvals. Capital Stamp, Dept. 10, Little Rock, Arkansas.

$1.00 (Cat. Price) for 1c. Two mint U.S.A. cat. 30c, queer countries packet (Djibouti, Manchuria, etc.), scarce set Russia, cat. 75c. Everything for only one cent to approval applicants! Garcelon Stamp Company, Box 4-8, Calais, Maine.

MOST lovely lady, Queen Astrid memorial stamp, Paraguay Bat stamp, Australian Anzac, Albania, Manchukuo, Palestine, fifty others. Only 3 cents to approval applicants. E. T. Dewey, Dept. H, 1036 N. Dearborn St., Chicago, Ill.

SMOKY Mountain commemorative sheet, largest U.S. stamp issued, and 33 U.S. including commemoratives, airmail, revenues, etc. Catalog 15c—To approval applicants for 3c. Gorham Stamp Company, Dept. C, Gloucester, Mass.

20 DIFFERENT large U.S. commemoratives and 50 different British Colonies for 3c postage to approval applicants. Palm Stampco, Seybold Bldg., Miami, Florida.

FINE Approvals freshly mounted. Fast, personal service. Tell me what countries you prefer and I'll send their stamps. Milton Skinner, 306 East Fourth, Long Beach, Calif.

SEYCHELLES, Nejd, Caymans, Manchukuo, Brunei, Turks Caicos, British Solomons (Cannibaland). Everything 3c with approvals. Viking, 130-P Canton St., Brooklyn, N. Y.

NORWAY King Haakon photogravure 5 one stamp banned by Nazis—only 3c to approval applicants. Free packet and lists included. W. T. Torgeson, West Englewood, N. J.

GIGANTIC Value 60 all different U. S.—old & new issues 25c. Bargains in other countries. Armour Stampco, St. Albans, N. Y.

STAMP Dealers—Your ad in this column will produce profitable business at low cost. Write for proof. O. K. Kelly, Dept. S-1, 353 Fourth Ave., New York, N. Y.

1942 STAMP Catalogue Free. Lists British North America, United States, Foreign. Free. Gray Stamp, Dept. PR, Toronto, Canada.

ASTONISHING! 100 Different 3c! Attractive approvals sent. United Stamp Service, 156-A North Ashland, Lexington, Kentucky.

204 DIFFERENT stamps including Kedah, Haiti, Cochin, Albania, Johore, Perak, only 10c to approval applicants. Reich Stamp Co., 4447 Kenmore, Chicago. Dept. 53.

FREE! Complete "United States" stamp catalog with 1,600 illustrations. Harris & Co., 99 Transit Building, Boston.

1000 GRABBAGS 15c each. U.S., Foreign. Sandy, 630 Bingaman, Reading, Pa.

FREE! Scarce Jugoslavia B33-4, complete set; to approval applicants sending 3c postage. Stamp Collectors Service, Box 335, Church Street Annex, New York.

U. S. COMMEMORATIVES, 50 different including S.P.A. Sheet, 15c with request for approvals. Empire Sales, Box 264, Springfield, Missouri.

CHARITIES—The hard to get stamps. 25 different including sets. 3c with approvals. Lyman, 97 Nassau Street, New York.

SPECIAL—Airmails—23 different. Including Zeppelin, Triangles, Latin-America, etc. 3c with approvals. Continental Stamp Co., Dept. C, Sandy Hook, Conn.

EGYPTIAN King Farouk Issue. Six varieties free to applicants for our 1c and 2c foreign approvals. Pladon Stamps, 1717A Idaho, Toledo, Ohio.

1000—U.S. mixed, containing old and recent commemoratives, high values, precancels, etc. 35c in coin. J. W. Dauber & Son, Bethesda, Md.

3c BUYS 4 Big Setal Salvador, Uruguay, Hungary, Manchukuo. Unexcelled offer for limited time. Approvals. F-S Company, Box 1,54, Houston, Texas.

UNITED States. Hard to get, yet inexpensive U.S. stamps in our approval books. 1500 varieties in stock. Southern Stamp Co., Box 70, Miami, Fla.

STAMP Collections Wanted. 6000 different or larger. For free appraisal and cash offer, send to N. Barcus, 3787 Longfellow, Detroit.

ZANZIBAR, Fiji, Nejd, Cayman, Thailand, Manchukuo, Uganda, Algeria. 3c with Approvals. Postrezel, P83 Windham, N. Y.

FREE! 25 different Chile—approval applicants! 3c postage. Wm Rad, Box P32, Rugby Station, Brooklyn, N. Y.

NEW Wholesale Catalogue. Fifty-eight page list free to dealers. Empire Stamp, Dept. 19, Toronto, Canada.

1000 GUARANTEED unpicked U. S. stamps with 1942 checklist, only 30c. Arrowstamps, Box 433 PS, Meriden, Conn.

10 FAMOUS Americans, 10 Presidentials, 10 Obsolete, all for 3c. U. S. Approvals. Nimac, 1357 Greenbay, Chicago.

1000 WORLDWIDE Stamp Mixture, 25c. Monjar, 1750 Fairmount, Cincinnati, Ohio.

ZEPPELIN and 24 Airmails 3c with approvals. Paltran, 2464 Grand Concourse, New York.

PATRIOTIC Collection. 175 different United States stamps for only 25c. Catalogs Free. Mission Mart, Brookland, D. C.

FREE [illegible] approvals. Pitto-ria's [illegible] Raymas, 1133-X Broadway, N. Y. C.

50 U. S., Canal Zone, Philippine. Approvals 10c. Stamp Shop, 813 Hollandbldg., St. Louis, Mo.

FREE: 50 different 3c postage. Packet Price List. B. F. Joyner, 660 University, Memphis, Tenn.

BIGGEST Bargain. Each dollar sent brings you eight dollars worth valuable stamps. Miller's Store, 36 Elm, Long Beach, Calif.

500 FOREIGN with valuable prize packet 15c. Approvals. DeMets, Box 1033, Milwaukee, Wis.

FREE! Canada Royal Visit complete with approvals. Chester, Box 343-V, Utica, N. Y.

SIX Liberia Airmail Triangles, complete set, 7c with approvals. Lorain Brown, Marion, Michigan.

FINE packet 75 different British Colonials, only 10c to approval applicants. Crescent Stamps, London, Canada.

EXCHANGE your duplicate stamps. List swappers, dime. Registrar, Box 2166, Denver, Colorado.

FIFTY different China for Approval request and four cents. Poggenburg, Jenkintown, Pa.

THREE Canadian Stamps value $1.05 for 25c with approvals. Colonia, Box 334, Place d'Armes, Montreal.

PITCAIRN Islands No. 1 free with approvals. Wollaston Stamps, Wollaston, Mass.

FREE Five beautiful Airmails, including Triangle, to approval applicants. Green and Co., Norwood, Ohio.

WONDER Approvals, Gift Package. Fairmount Stamp Mart, Box 3211, Philadelphia, Pa.

PENNY Approvals that satisfy. Neil Gronberg, Box 64418, Philadelphia, Penn.

MINT Rogers Clark—50 different U. S. 10c, 62 different British Colonies 10c. Kaye, 1925-B Quentin Road, Brooklyn, N. Y.

100 DIFFERENT U. S. 60c—Fifty 15c—Approvals. Bill Sisson, Dept. PS-2, Decker, Indiana.

1000 MIXED foreign 25c. Well worth sorting for values. Plaza Stamp Co., Santa Fe, N. Mex.

AUSTRALIA War Commemoratives including others—5c. Approvals. Mayber, Box 306 S, White Plains, N. Y.

MUTINY on the Bounty! Beautiful Pitcairn Islands set. Only 5c with approvals. Walter's Stamp Co., Box 65, Detroit, Mich.

50 DIFFERENT U. S. many commemoratives, 3c. Gerhardt, 2804 Rio Grande, Austin, Texas.

77 ANGOLA, Bosnia, Mozambique, Selangor, Tonga, Uruguay, etc. 3c. Lulbery, Middletown, Conn.

BEST One cent approvals in America. Elvin Stanton, Niantic, Conn.

SOUTH American—100 different 10c—with approvals. Davis, Silver Lake, Ind.

SURPRISE Packet, 10c. Approvals. Stephen Link, Box 1978, Union, New Jersey.

300 MIXED U. S. old and new, 10c. Weatherby, Amherst, Ohio.

PRECANCELS 100 different, 25c. 30, dime. United Collectors, Willow Spring, Illinois.

FIFTY Different United States. Dime. Approvals. Brenner, Main, Plaistow, N. H.

1000 MIXED stamps, 38 cents. Earl Jackson, 159 Clifton, Youngstown, Ohio.

FREE packet and Xmas literature. Box 4618, Northeast, Kansas City, Mo.

12 SETS 10c. J. L. Stamp Co., 6 Elmwood Blvd., York, Pa.

10,000 VARIETIES 1c each! Gordon Davidson, Box 565D, Manchester, N. H.

TATTOOING SUPPLIES

START profitable tattooing and removing business. Free instructions. Write Tattooer, 651 South State, Chicago.

TATTOOING Outfits, Supplies. Illustrated List Free. Percy Waters, Anniston, Ala.

TAXIDERMY

GLASS Eyes For Taxidermy for birds, animals, fish, decoys. Genuine Enameled Eyes. Made in our new factory. Elwood Supply Co., Dept. 334, Omaha, Nebr.

TRAPPERS

TRAP Fox or Coyote. Bare ground and deep snow trapping. Free circular. Q. Bunch, Welch, Minn., Box T.

TREASURE FINDERS

BURIED Treasure! Goldak Radioscope, money-back guaranteed, finds buried gold and silver. Patented. New powerful 1942 models ready. Write world's largest manufacturer. The Goldak Co., Dept. S., 101 S. Broadway, Los Angeles, California.

MT SCOPE Metal Locator fully guaranteed and unsurpassed in efficiency. Time payment plan. Trade-in and accessories. Free literature. Fisher Research Laboratory, Palo Alto, Calif.

WANTED—MISCELLANEOUS

HIGHEST Prices for used Cameras, Binoculars, Microscopes, Drawing Sets, Tools, any optical or scientific Instrument. Satisfaction guaranteed. Gordon's, 162-S Madison, Chicago.

MERCURY. Cash paid promptly. Quotations free. Mercury Terminal, Norwood, Mass.

WATCHES

WATCHMAKERS Materials, Tools—Watches Bought, Sold. Best prices for Old Gold, diamonds. Free Catalog. Ben Sesai Company, Box 150, Chicago.

WELDING, SOLDERING

BUILD D. C. Arc-welder, without rewinding armature. Light Plant generators, D.C. Motors, Automobile generators. Plans $1.00 each. Welders Club, WB-1433 M-Mart, Chicago.

BARGAINS. Demonstrator arc welders, gasoline and electric drive. Build your own portable, save $500. Liberal Trial. Easy terms. Write Hobart Welder Exchange, Box P-24, Troy, Ohio.

BUILD 60-200 Amp. A-C welder for $15. Several plans $1.00. Information dime. H. Prent Electric Products, Dept. W, Bellefontaine, Ohio.

SAVE 50% on A.C. Arc Welders—Plans. Holgerson, Canton, Kansas.

Not Everyone does as Well—*but J. S. Corbit reports*

Took in $279.50 on first jobs *in my* Own NEW Business!..

● How would YOU like to own your own business and get $3.00, $5.00 or even $8.00 for an hour's work? How would you like to be able to start making money the VERY FIRST DAY!

Here is a NEW FIELD for live-wire men which offers a fine opportunity for you to get into business for yourself. You don't need special training—you don't need a lot of money. We can start you in this business where you will be your own boss and where money *comes* in faster and easier than from an ordinary job. This business is NEW but letters are already pouring in, telling of large profits earned the very first week. Our new electric furniture cleaning machine washes upholstered furniture beautifully right in your customer's home. There are thousands and thousands of customers everywhere. Hotels, clubs, hospitals, public institutions of all kinds, as well as homes, are all your prospects. They are ready to PAY BIG for this service.

FREE VON SCHRADER MFG. CO., 611 Pl., Racine, Wis.

Send me (without obligation) your free booklet telling me how I can own my own business and become financially independent and how I can pay for the DETERGER on easy terms.

Name.....

Address.....

City.....State.....

No Rent to Pay

Your home is your office, therefore you have no extra rent to pay. TAKE THE MACHINE TO THE JOB and do the work in your customer's home the cost left your money the same day. Think of these amazing opportunities.

Earn a Home—Earn a Car—Earn Big Pay

Even in spare time you can earn a lot of money. If you want a new car or extra money for only a home, get busy making business NOW. Send the coupon for FREE BOOK telling you how you can have a business of your very own.

In reading these reports of large earnings, note that they are gross figures made by good men for specific periods and do not reflect continuous operations, but they do give you an idea of what a live-wire can do in his busy seasons.

"My profits with the Detergen have been more than satisfactory. One job paid $18.00 for 7 hours work, another $24.00 for 8 hours and my customers report it looks like new. Just wonderful, etc. J. W. B.

●

"Many of my jobs run from $6.00 to $10.00, for work which I can do in one day without any extra help. Be sides every customer has become a booster for me." A. F. N.

●

"Have often taken in as high as $7.00 in a single day. My best profit for one week was $270.75." E. B. W.

●

Made $28 one afternoon. Machine very fast. W. Shipstead.

Customers All Satisfied . . .

Your customers are always satisfied. They send their friends to you and this list should roll in and help you to make more money. IT WILL MULT the work done in your customer's home. YOU never have to cart the work back and forth. YOUR CUSTOMERS can use the furniture almost as soon as it is cleaned.

Guarantee

Every machine is made in our own factory and we fully guarantee the quality of materials and workmanship. We also help you get started and make it possible for you to earn real money. The entire outfit comes to you ready to use.

Easy Terms

The price is very reasonable and a down payment brings everything to you complete, the balance you can pay just a few dollars monthly. OWN YOUR OWN BUSINESS—let us help you start now. Send the coupon above for FREE BOOK "Your Own Business, Profits Instead of Wages Now."

VON SCHRADER MFG. CO., 611 Pl., Racine, Wis.

DO YOU OWN A RAILROAD?

Here at last is a new and complete handbook for the Model Railway enthusiast. Shows you how to save real money building and laying your own track, making an automatic signal system, constructing bridges, culverts, tunnels, stations, semaphores, water tanks, coaling treatles, roundhouses, turntables, crossing gates, switches, etc. The detailed instructions and diagrams in this great book make it easy.

EVERY MODEL RAILWAY ENTHUSIAST NEEDS THIS NEW BOOK

Tells you how to utilize every bit of available space in laying out your system. How to turn out smoke stacks, fire boxes, boilers, and wheels, in your own shop. Complete, easy-to-follow instructions for building a box car, gondola, refrigerator, tank, hopper, caboose, day coach, pullman, baggage, and observation car. Complete plans, specification, instructions, and scale blueprint for building the popular Atlantic type locomotive.

Send only $2.00 for your copy of Model Railways or we will ship C. O. D. plus a few cents postage. *Satisfaction guaranteed or money back.* Address

Popular Science Monthly, Dept. 12
353 Fourth Ave. New York, N. Y.

Now you can know at sight 60 of the latest airplane types you read about and see in movies! This amazing 64 page booklet gives pictures, with specification and performance charts, of U. S. Boeing, Curtiss, British Spitfire, German Stuka, Italian Breda, Russian ARK 3, Japanese Mitsubishi and other famous fighting, commercial and private planes. Send coupon with only 10c.

Shows Fighting Planes of All Nations

National Aeronautics Council, Inc.
Dept. 101, 37 West 57th St., N. Y. C.

Yes I want the illustrated booklet WINGS OF THE WORLD. Send it, postpaid, without obligation on my part. I enclose a dime.

Name.....

Address.....

FOR YOUR OWN ENJOYMENT

THE MOST PRACTICAL, EASY-TO-FOLLOW MANUALS EVER PUBLISHED

These practical, easy-to-understand handbooks will help you get the most out of your hobby. Written by experts especially for Popular Science Monthly readers, they are invaluable to the mechanically minded man. Each book is fully illustrated, with pictures and diagrams. Bound in sturdy library cloth. You need not hesitate to order them for yourself or for gifts. We guarantee complete satisfaction or money back.

FIX IT YOURSELF — 256 pages, $1.00

Save yourself a lot of expense by doing your own odd repair jobs. This famous book shows with diagrams and directions how to fix and repair furniture, electric outlets, windows, doors, leaky pipes, floor boards, chimneys, boilers, weather proofing, painting and hundreds of other construction and repair jobs. Picture diagrams show how each job is done. 256 pages. Full cloth bound, $1.00.

RADIO BEGINNERS SIMPLIFIED MANUAL $2.00

Every radio operation from trouble shooting, to building and improving marvelous long and short wave sets, is made so simple and clear that you just cannot fail to understand many things that may have puzzled you before. A few minutes a day with this manual will teach you what it takes years to learn without it. Prepared by technical radio experts who KNOW how to explain things for non-technical radio enthusiasts. Cloth bound, 256 pages, hundreds of simplified drawings and diagrams, $2.00.

THE BOOK OF FORMULAS — 250 pages, $1.00

The basis of many fortunes! Formulas, recipes, methods and secret processes for making and improving upon beverages, glues, cements, enamels, paints, cosmetics, dyes, inks, tooth pastes, soaps, silver and nickelplating, oils, lubricants, and a thousand and one things for commercial and household use! Your fortune may hang upon one little hint from this most amazing of books! Information from a thousand sources—not normally available to the general public—now published for the enjoyment and practical profit of our readers, cloth bound, $1.00.

ELECTROPLATING — 260 pages, $2.00

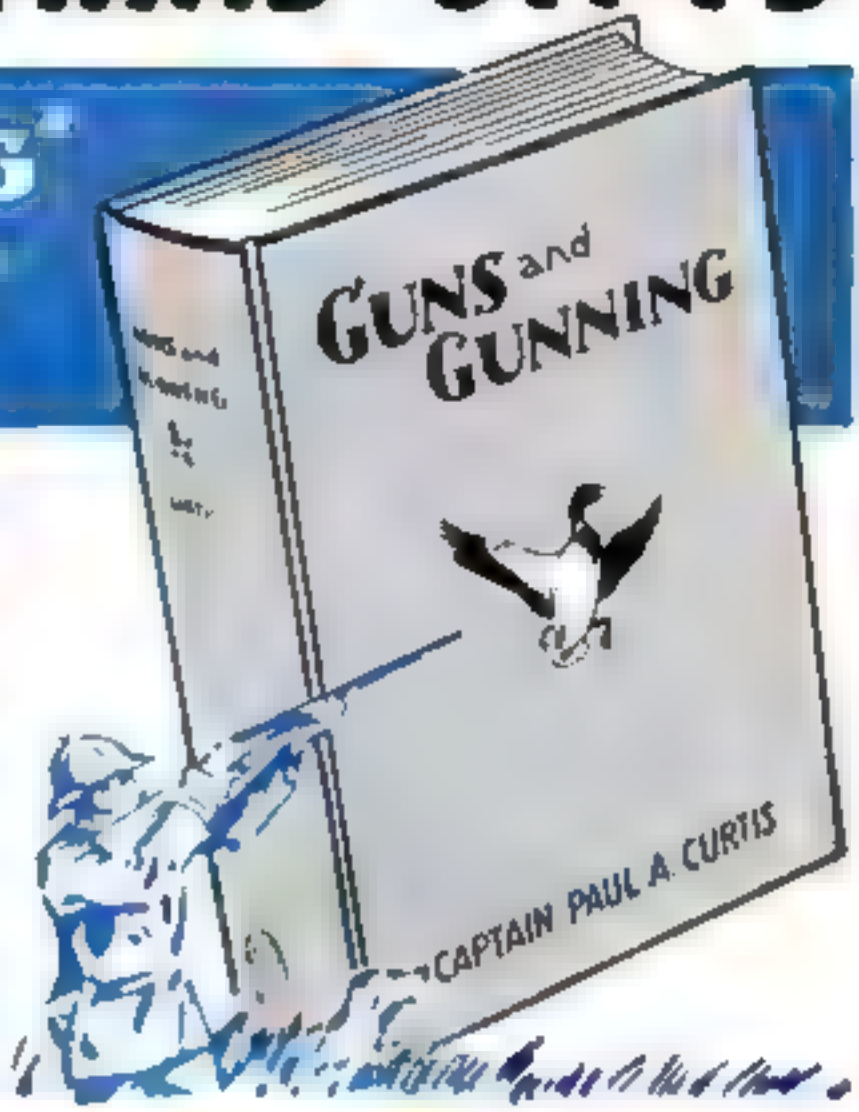
Written especially for the amateur, this book tells you how to utilize many odds and ends to build a complete home electroplating workshop. Instructions, pictures, and diagrams show how easily you can do copper, nickel, chromium, silver and gold plating. How you can plate household or automobile fixtures, hardware, tools, silverware, ornaments, clocks, watches, bracelets, rings, metal parts of all kinds. Scores of illustrations, diagrams, and pictures. 260 pages, cloth bound, $2.00.

OR FOR CHRISTMAS GIFTS

"GUNS and GUNNING"

THE MOST COMPLETE GUN BOOK EVER WRITTEN

FORMERLY $3.00 NOW ONLY $1.95



A cyclopedia of information for sportsmen! A reference book that you'll refer to always! A bargain that may never come again!

"GUNS AND GUNNING" brings you hours and hours of stimulating reading about every kind of firearms. Everything you ought to know about rifles and their uses—sights and their adjustment—shotguns with heavy and light loads—the proper choice of weapons and ammunition—how to care for your firearms—skeet and trap shooting—bird shooting—big and small game shooting—is included in this giant 384-page book!

No matter if you are a beginner or an expert, as long as you love guns, you'll find "GUNS AND GUNNING" worth many times the modest price of $1.95!

"JUST FISHING"

THE BOOK THAT BRINGS THE JOYS OF LAKE AND STREAM TO YOUR EASY CHAIR

FORMERLY $3.00 NOW ONLY $1.95

The secrets of successful fishing opened up before your eyes! Not just dry theory but actual, workable methods for getting better results.

Beginner and expert alike will learn much from this great book which has rightly been called the fresh water fisherman's Bible. Written in a simple, easy-to-read style, the author pays close attention to details which most writers overlook.

All Eastern game fish and how to get them are fully described—with pictures and illustrations galore. Yet at this temporary low price of $1.95 "JUST FISHING" costs no more than a few new lures! 418 pages, 17 full-page plates, 80 flies and lures in full colors.

SEND NO MONEY NOW!
TEAR OFF AND MAIL THIS COUPON TODAY

POPULAR SCIENCE, DEPT. 12A, 353 FOURTH AVENUE, NEW YORK, N. Y.

Please send me the books I have circled below. I will pay the postman the price shown plus a few cents postage in full payment when the books are delivered. (Money back if not satisfied.)

Fix It	$1.00	Radio Experimenter	$2.00	Guns and Gunning	$1.95
Electroplating	$2.00	Formulas	$1.00	Just Fishing	$1.95

Name .....

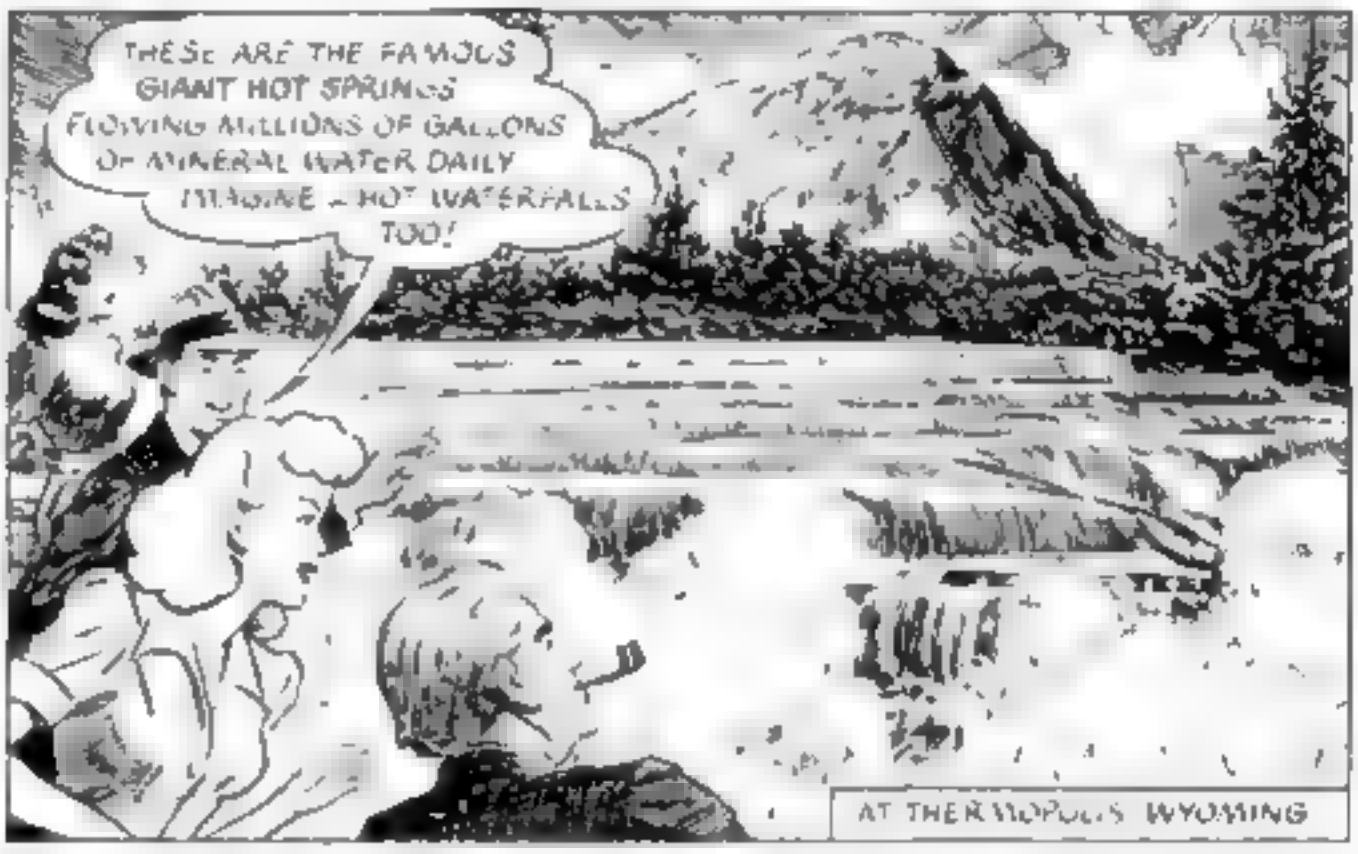
Address .....

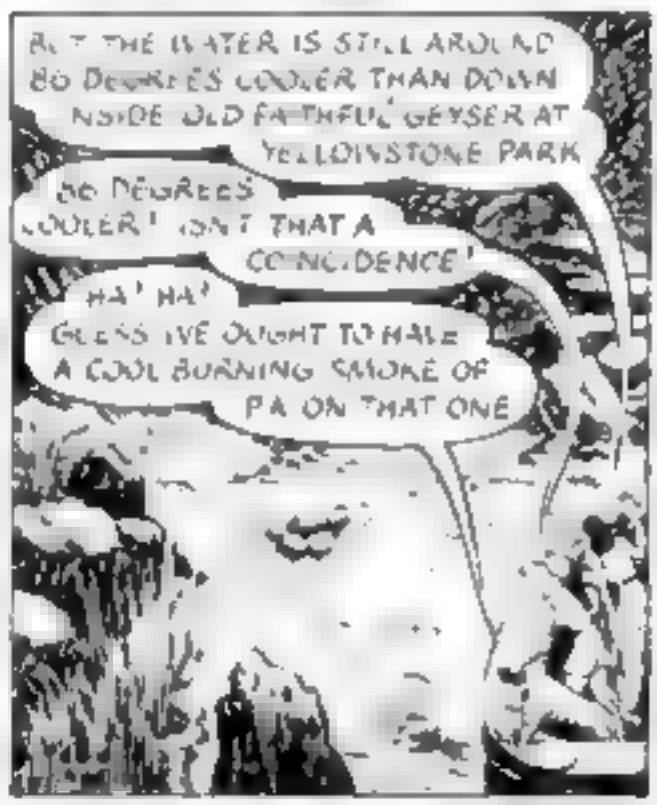
City ..... State .....

If you remit now we pay postage. Orders from outside U. S. A. cannot be sent C. O. D.

WONDERS OF AMERICA

Hot Waterfalls!

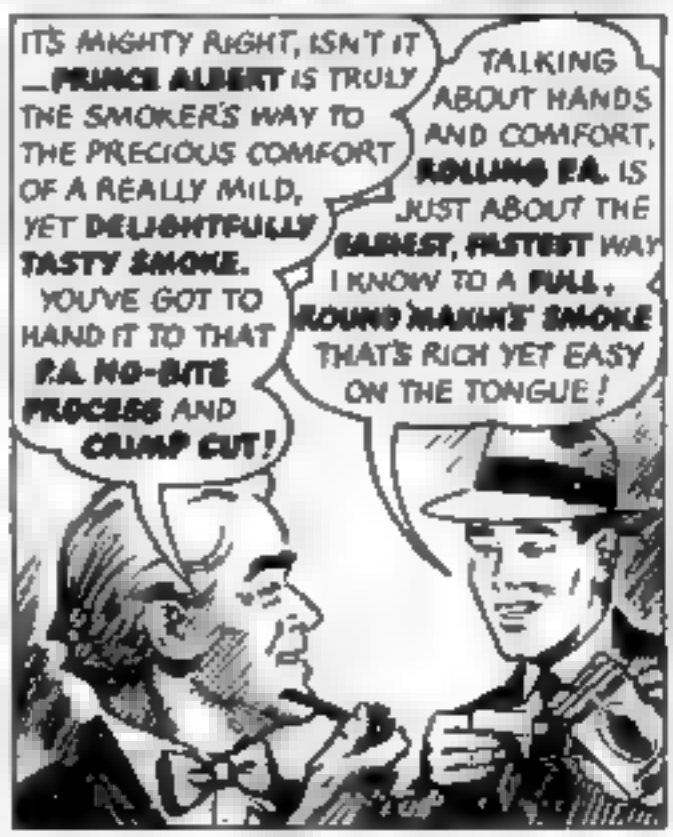




IN RECENT LABORATORY "SMOKING BOWL" TESTS, *PRINCE ALBERT* BURNED

86 DEGREES COOLER

THAN THE AVERAGE OF THE 30 OTHER OF THE LARGEST-SELLING BRANDS TESTED— *COOLEST OF ALL!*



Death Rays for Bacteria

Mercury-Vapor Lamps Preserve Food and Help to Safeguard Human Life

This moldy, spoiled bread, three days old, was sliced and wrapped in plain air

By KENNETH M. SWEZEY

INVISIBLE ultraviolet radiations, long a weapon in fighting disease germs, today carry the battle against bacteria into industry and the home.

Generated by new tubular mercury-vapor lamps, these death rays to microörganisms help keep food from spoiling in storage plants, display cases, and one brand of home refrigerator. Combined with controlled temperature and humidity, they form the basis for a revolutionary meat-tenderizing process through which juicy, tender beef, of the kind once served only in the best restaurants, can compete with unprocessed beef. Irradiated in air-conditioning ducts in factories, public buildings, and homes, these rays minimize contamination of both food

Microörganisms "blow up" under Sterilamp rays. 1. Normal paramecia. 2. Thirty seconds exposure distends them. 3. Swelling continues as cells weaken. 4. They explode and die. At left, a loaf of bread which was sliced and wrapped under the rays of the Sterilamp. It is free from mold after three days

Tenderayed sides of beef are inspected as the bactericidal rays work. Glasses must be worn by employees, as ordered by the sign above, for the rays inflame the eyes, but cannot penetrate glass

Four weeks of hanging to tenderize beef causes ten percent loss by draining, evaporation, and mold and discoloration which must be cut away, but with mold and bacteria killed, waste is at a minimum. The waste in four pounds of meat by the old and new processes is illustrated at the left

and drug products and the human body.

The development of the Sterilamp, the tube which has opened these new horizons for ultraviolet radiation, took a decade of research by Dr. Harvey C. Rentschler, director of the Westinghouse lamp works laboratories. Hundreds were built and tested. Special glass to filter out ozone-producing rays, yet permit bactericidal radiations to pass, were developed; different combinations of gases and voltages tried; a meter devised to measure radiation at different wave lengths; billions of bacteria raised and killed to check the efficacy of the rays in practice.

The result is a lamp containing a mixture of mercury vapor and inert gases, which emits rays, 80 percent of which are specifically in the bacteria-killing region of the ultraviolet spectrum—about 2,500 Angstrom units, or 1/100,000 inch long. It gives little light, almost no heat, and just enough ozone to kill bacteria in shadows which

Dr. Harvey C. Rentschler holds a meter for measuring ultraviolet radiations from the Sterilamp on which he put ten years' research

Sterilamps add a fifth element to air-conditioning—to controlled temperature, humidity, circulation, and filtering, they bring controlled bacteria. At left, lamps are installed in the air-conditioning duct in a drug-packing room in the Bristol-Meyers plant. At right, they keep drinking glasses sterile

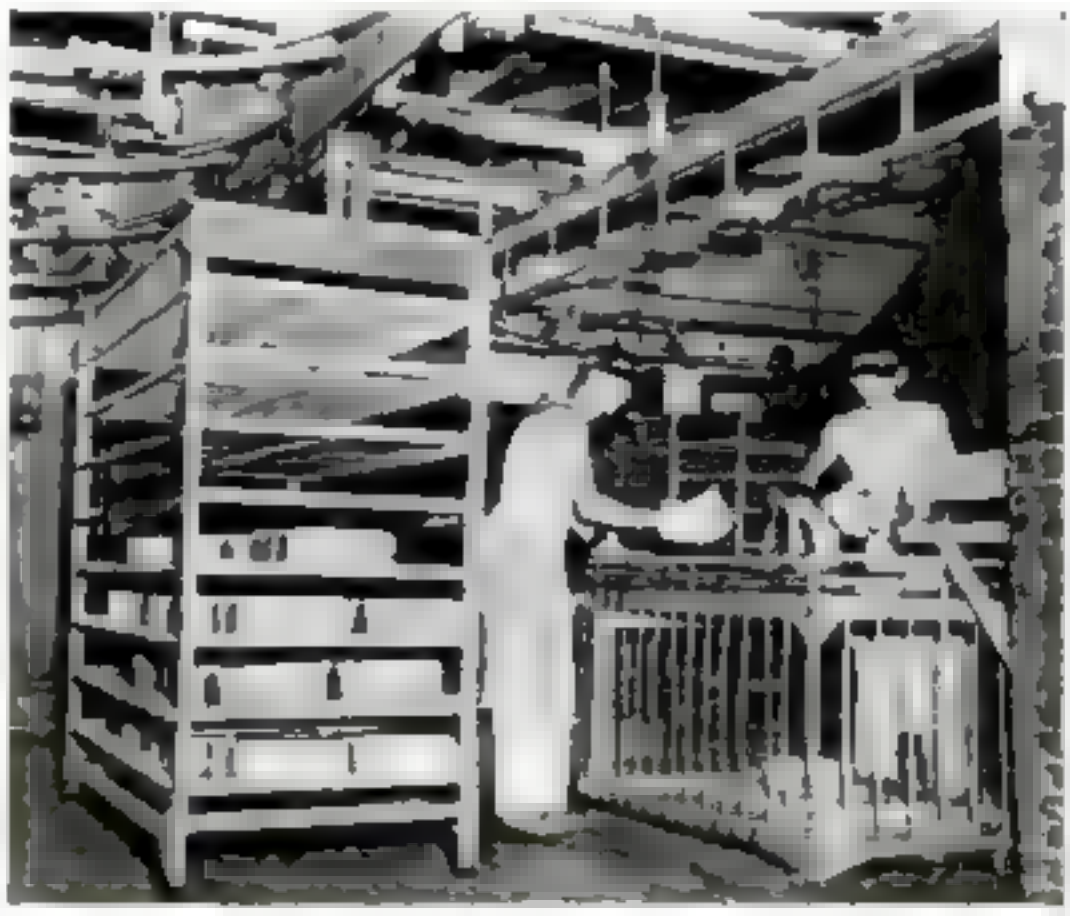
direct rays cannot reach. Requiring an input of only 15 watts, a 30-inch Sterilamp will kill bacteria in the air above 30 square feet of floor.

Why the bacteria are killed is not known, yet the process may be seen under a microscope. Paramecia, larger than bacteria and used for observation, are slowed down in a drop of water as soon as the Sterilamp is turned on, huge blisters appear, and a moment later they disintegrate.

One of the first big uses for the Sterilamp was in meat storage, where bacteria and mold spores had caused great waste. The Tenderay process, patented by Westinghouse and developed commercially in cöoperation with the Mellon Institute and the Kroger Grocery and Baking Company, soon followed.

Meat, especially beef, required four or five weeks of hanging in a temperature of 33 to 36 degrees for its tissue to change to a form which makes the meat tender—during which time it acquired a thick coating of "whiskers" and slime, which were cut off, and lost considerable weight by evaporation. By using Sterilamps to prevent mold and bacteria growth, the temperature could be increased to 62 degrees and the humidity to 85 per cent, and tenderizing could be completed in 48 hours. The resulting beef required no trimming, and lost less than one percent of its weight by evaporation.

In summer, mold also caused an appreciable loss of baked goods. As the most troublesome is that seeded during cooling and waiting for wrapping, Sterilamps were installed in bakery slicing and wrappng rooms. They have since found use in all types of fresh food storage, in sterilizing bottles, dairy utensils, and drinking glasses, over cows in barns and chickens in poultry houses. One company has applied Sterilamps to the sanitation of toilet seats. A large manufacturer of pharmaceuticals has installed them in the air-conditioning system of his packing rooms.



Used in the slicing and wrapping rooms of a bakery, Sterilamps rid the air of bacteria and mold spores at the source, and prolong the keeping quality of bread

Whether It's a Mammoth Machine,
a Telephone Pole, or Your Own Home

Weld It

—Says R. G. LeTourneau

It takes the largest tires in the world, $6.00 x 40", costing $5,000 each, to transport one of his welded jobs—a $50,000 dirt mover

By HICKMAN POWELL

ROBERT G. LETOURNEAU first saw a welding torch when he was 18 years old, while he was helping clean up the ruins after the San Francisco earthquake of 1906. It was just a primitive, old-fashioned hydrogen-oxygen blower, but it fired his imagination and became the basis for his whole mechanical career, one of the most creative in his generation.

When geographers of the future study the changes in the earth's crust in this century, they may well consider this inconspicuous incident more significant than the earthquake itself. Compared with the face-lifting which the surface of America is getting today from the giant earth-moving machines which grew out of R. G. LeTourneau's passion for welding, the San Francisco catastrophe was a mere topographical ripple.

In the Arabian Nights tale, Aladdin rubbed his wonderful lamp and the miracle-working genie came forth to build castles at his bidding. LeTourneau went to work with his welding torch on a pile of scrap steel in the back yard of his home at Stockton, Calif., and before he was done this mechanic had pyramided his welding kit into an $18,000,000 fortune.

From his torch came those fantastic mechanical behemoths, the Tournapulls and Carryalls, which piled dirt for the big dams and pushed through the great highways of the 1930's. Today they are remaking the surface of the land at hundreds of factory sites, naval bases, Army cantonments, and military airports. Their production, which had multiplied a hundredfold in a decade to a volume of $10,000,000 in 1940, was well started toward doubling again in 1941, with no limit in sight.

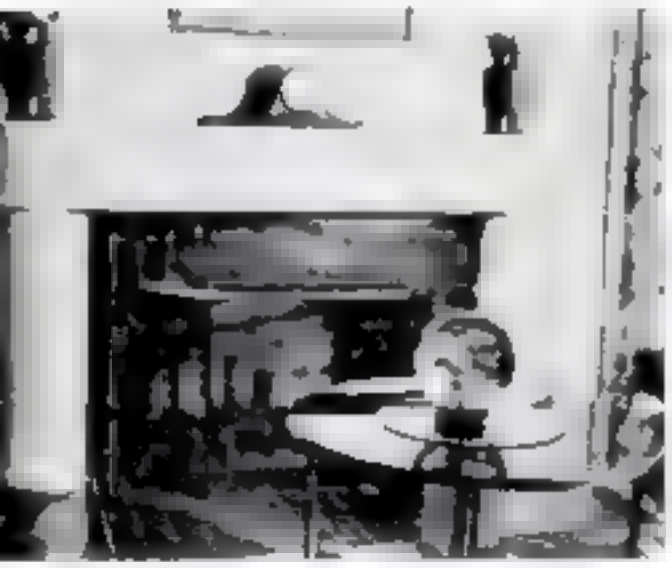
Just one Tournapull outfit, out of them all, scrapes up from 15 to 45 cubic yards of dirt at a bite, lifts it off the ground, and trundles it away at 20 miles an hour. LeTourneau now has a 60-yard scraper on the way. At this rate, the aggregate dirt-moving capacity of working LeTourneau equipment may soon compare favorably, on a tonnage basis, with that of the Mississippi River System. By comparison, Aladdin's genie was a piker.

Down in the backwoods country of northern Georgia, where less than five years ago were only wooded hills near the little town of Toccoa, there is today a thriving, roaring industrial community built entirely of welded steel.

It all happened suddenly. One day arrived a number of vast welded-steel Tournapulls, on giant rubber tires, which trundled themselves up to a hilltop and started biting it off in large chunks. Within a few days the hilltop was a wide, flat plain, and soon appeared on it a half dozen great flat-roofed factory buildings, offices, and a cafeteria—all built out of LeTourneau-fabricated, welded steel panels, which were merely set up like so many large blocks and welded together at the seams.

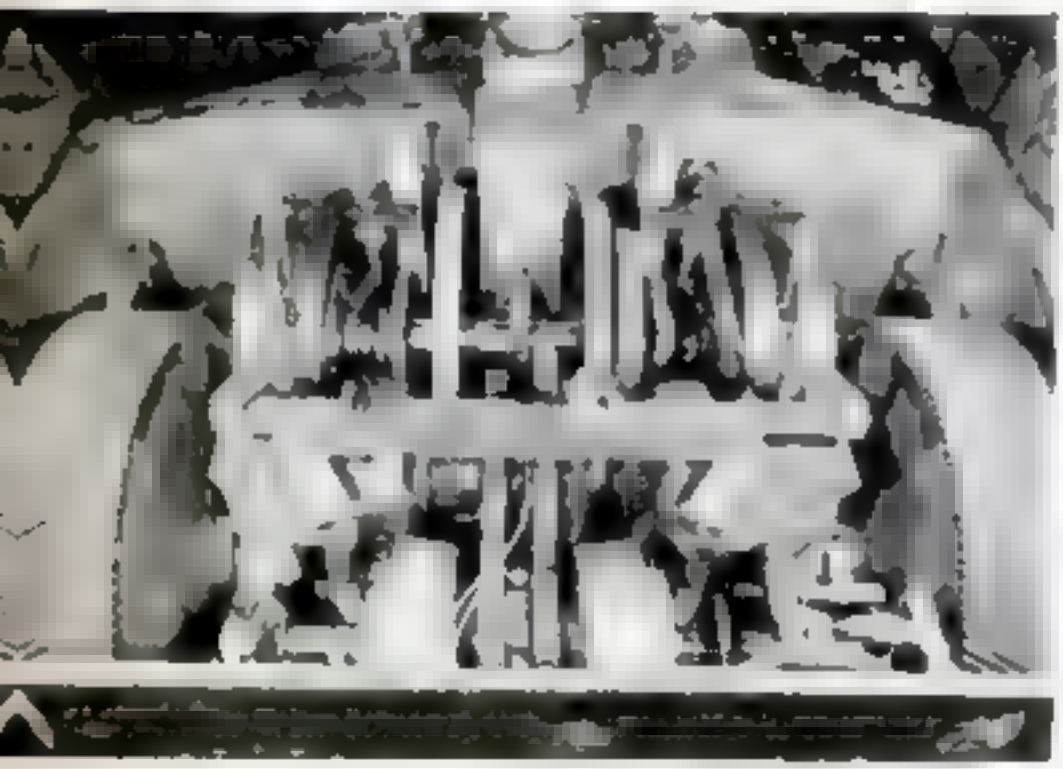
Another hilltop became an airport, with a welded-steel hangar for LeTourneau's five airplanes. Tournapulls dammed a valley and it became a mile-wide lake, on whose shore was built a 350-bed hotel, all of welded steel panels, including an unsupported dome 100 feet in diameter over the circular central lobby.

On two hilly streets near the factory appeared rows of five and six-room houses for employees, the one-story "modern" style—

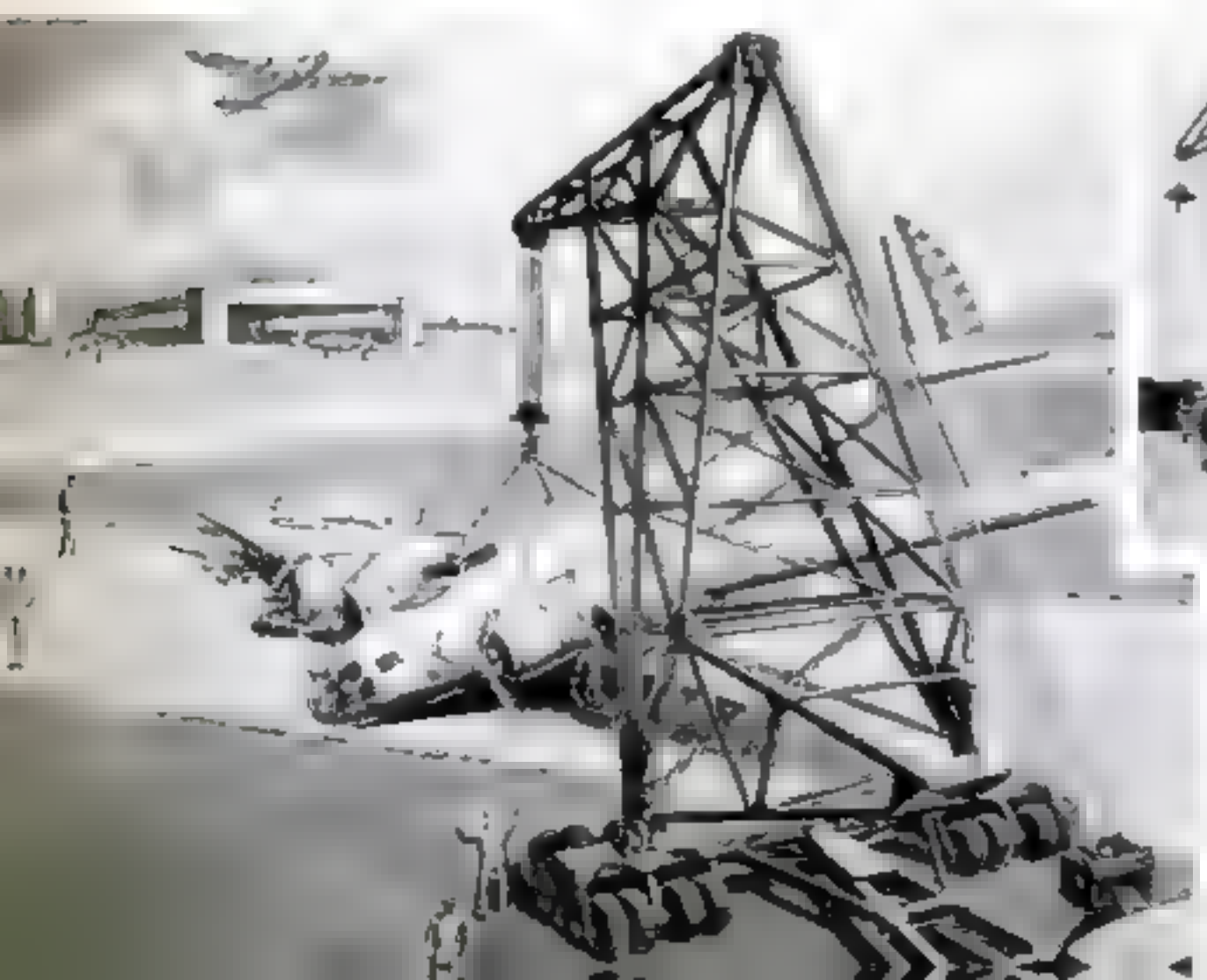


HE WELDS EVERYTHING, from the graceful mantel in his own home to a husky rooter like the one at the right. They used to say of LeTourneau that he welded the buttons on his pants

Newest and biggest of the Tournapull tractor units is this experimental model powered by twin Diesel engines, here hitched to a Carryall scraper. The tires are the biggest ever made, of 9½-foot diameter



This is the gearbox of the Tournapull pictured above, set between the wheels. At right is a standard-model Tournapull dragging a Carryall



A mobile welded steel crane, moved and powered by a Tournapull, is one of LeTourneau's creations. A suggested adaptation of this machine is a huge crane for lifting damaged planes off runways

all of them built of welded-steel panels from floor to rooftop.

In the factory a mountain boy who came two years ago from the forks of the creek puts a weird goggled welder's mask over his freckled face and runs an electric arc along a seam of steel, building a machine to lift 90 tons of dirt. A few hundred yards away his hill-reared wife sweeps up her new steel house, takes in the milk (which comes from a welded-steel dairy barn) while listening to radio music from a welded-steel radio studio, and then hangs out the family wash on welded-steel posts.

Everything in this Toccoa development is of LeTourneau-built steel except the tops of the drafting tables. Except for such things as gas engines made by other manufacturers, you could probably hunt all day without finding more than a handful of nuts, bolts, or rivets.

The street pavements are not of steel, but that does not necessarily mean the idea has not been thought of. Not long ago, LeTourneau demonstrated on a busy corner of Atlanta a steel device called a Tournapass. In three sections, welded together on the spot, it was an overpass large enough to carry a continuous flow of one-lane traffic while cross traffic moved uninterrupted.

Right now LeTourneau has a little sideline job of making 1,000,000 artillery shells for the Government. He has not yet found any way to make a shell with a welding torch, but they will be turned on specially designed lathes of welded construction, whose demountable heads can be removed and retooled for a new job almost at a moment's notice.

As president of the corporation, "R. G.," as they call him, still runs everything like a one-man business. He is all over the place, a tall, big-boned man of 53, with broad, hearty gestures, and a big laugh booming from a big mouth, riding around the factory on a little motor-driven scooter to save time. He is less likely to be in his office than leaning over an apprentice's shoulder at a lathe, or winding his long legs around a high stool to show a young draftsman an idea, or turning an electric arc on some experimental patterns of steel. Once, after an automobile accident, he had himself wheeled around the plant every day on an operating table.

LeTourneau has no designing or engineering department—does it all himself. He has none of the disadvantages of conventional technical training. His only schooling, beyond the first half of the eighth grade, was a correspondence-school course in trigonometry and geometry which he feels contributed a great deal to his success. His associates say he can work complex mathematical problems in his head while others are still fooling around with logarithm tables and slide rule.

LeTourneau quit school at 14, and during the next four years worked in foundries from Portland, Ore., to San Francisco. He won his master molder's card at 18, and thereafter had little interest in so static a thing as cast iron—though he has designed permanent steel molds for castings he needs in his own factories. He then spent a year on his father's farm, clearing land and studying trigonometry. In the spring he sold 100 cords of wood and with the proceeds went into the garage business at Stockton.

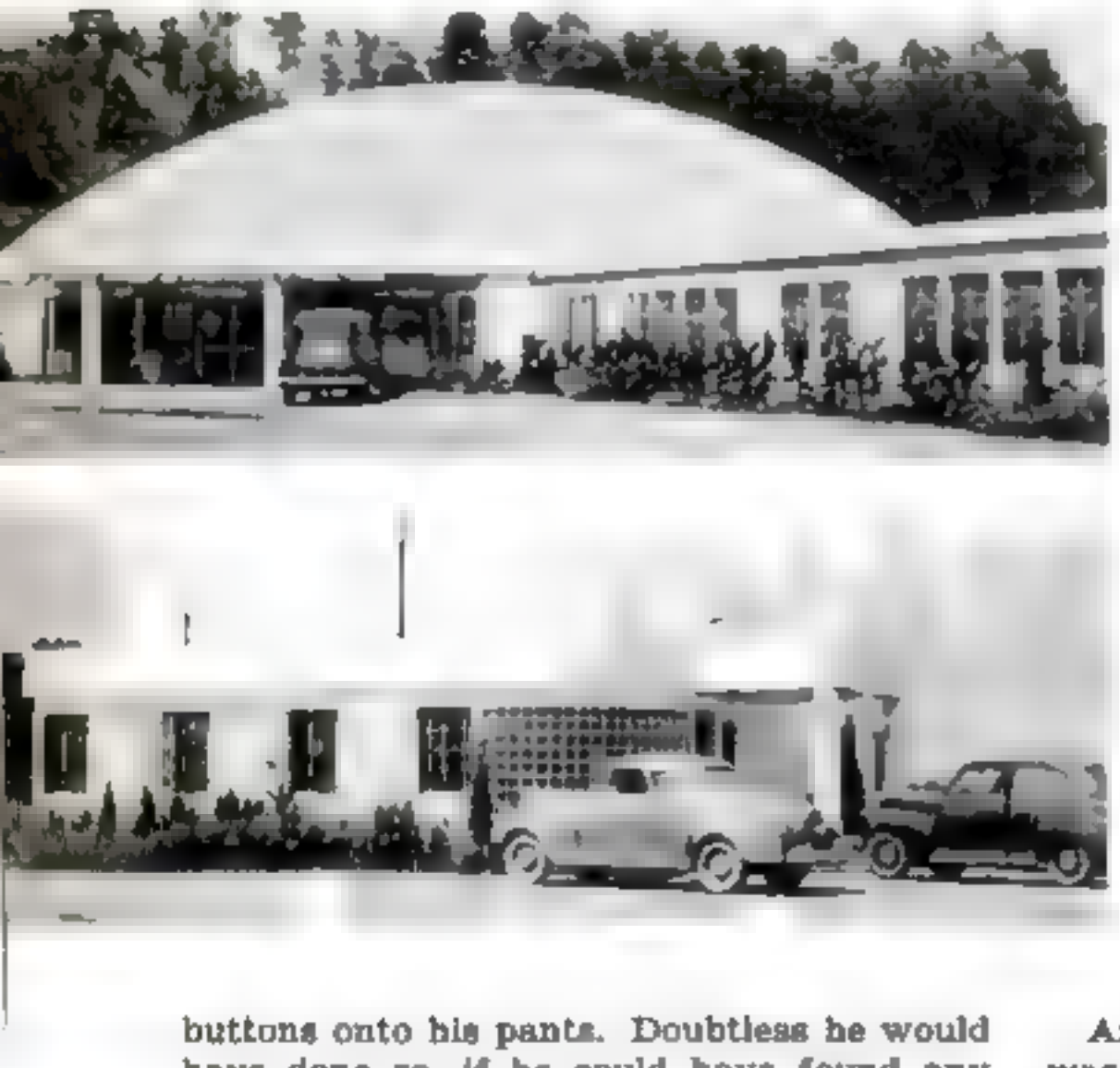
One of the first bits of equipment he bought was a welding torch—one of the newfangled oxyacetylene kind, good for working steel. Wherever he went, that was the first thing he put into his car. It came in handy on innumerable repair jobs, and was always useful for making things. Then, as today, he always made things himself according to his own ideas, in preference to buying them. If possible they were welded, of steel. It was said in those days that Bob LeTourneau welded the

The Wizard of the Welding Torch designs and builds nearly all of the machinery used in his plants—and you have to hunt to find a bolt or rivet. This is a special lathe with demountable head to make retooling an easy job

LeTourneau's own home at Toccoa, Ga., is of welded-steel construction, built of rectangular plates . . .

. . . stamped out with the powerful press shown below. This building method was first developed at the Peoria, Ill., plant, for employee housing, and has been adapted to all kinds and sizes of structures

Below is the 350-bed hotel on the LeTourneau-made Lake Louise. An unsupported dome of welded steel, 100 feet in diameter, covers its vast central lobby and auditorium



Toccoa's radio station WRLC, at left, was welded together in the plant and carried bodily to its site by a crane like that shown on page 54

buttons onto his pants. Doubtless he would have done so, if he could have found any way to make steel pants.

During the World War he worked at the Mare Island Navy Yard, and when he returned to Stockton he found nothing left of his garage business except debts. Thirty years old, with a family to support, he was walking down the street wondering where to look for a job, when the future tapped him on the shoulder. A man asked him to come out on a farm and fix a tractor. When that was done, he had the job of driving it for a while, grading land. Then he bought himself a tractor, on credit, and went into business as a land-leveling contractor.

The scrapers used in those days were little better than the old horse-drawn scoop, which carried a third of a yard. LeTourneau was dissatisfied with them, and the evolution of today's Carryall began.

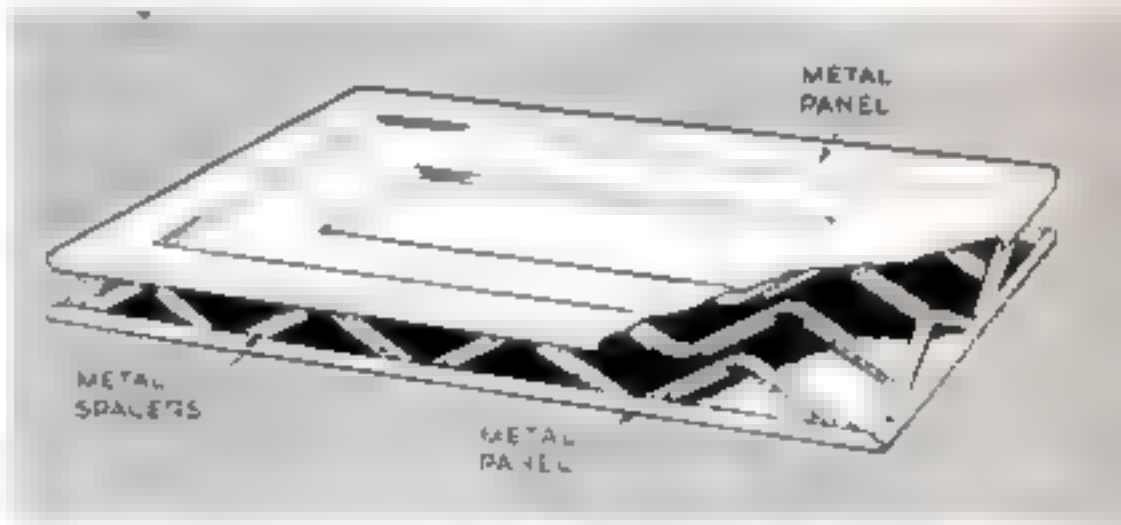
An immediate ancestor of the Carryall was a trailer he built to run behind his model T on rough ground with a heavy load, to where his tractor might be broken down. He built it with big tires and heavy, solid axles, no springs. People thought he was nuts to build a trailer without springs, but it went sailing over the bumps with loads that would have broken any spring trailer. The Carryall is basically such a trailer, with a boxlike "bucket" to scrape up the dirt and then lift off the ground.

His first scraper took a three-yard load, and was so fast by current standards that it made his contracting jobs profitable. When he built a bigger, better one, he had no trouble selling the old one for a good price. It went along that way for a while, with the builder accumulating the first of his string of 50 patents.

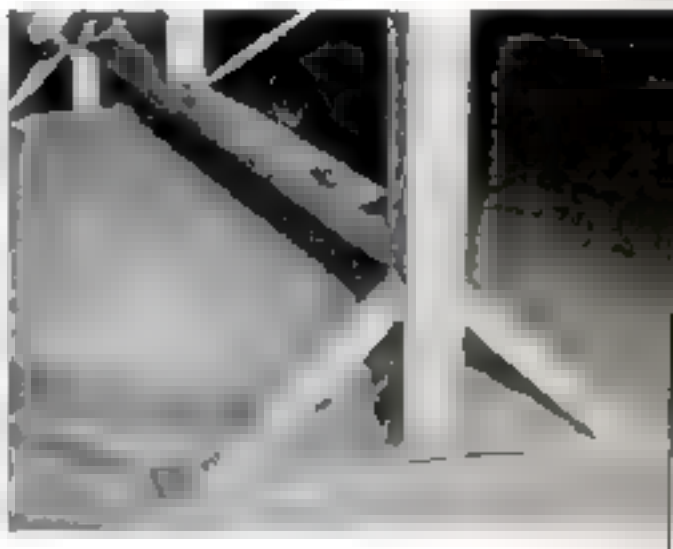
In 1925 he sold a patent for $50,000. This

To house his five planes, LeTourneau built this big hangar. Even the sliding doors are of steel panels. The wide expanse of roof is supported by one pillar

LeTourneau points to a steel panel in a building wall. Set edge to edge, the panels are welded at the joints and insulation is forced inside them



Basic unit of welded-steel building construction is a panel made of rectangular plates held apart by light diagonal braces as shown in the drawing. Even the drafting tables in the factory are of steel (right), with only their top surfaces made of wood



was an idea for telescoping buckets on a scraper. As the load gets bigger in a scraper, it must be pushed back by any additional dirt that is picked up, and this calls for more power. By putting two or more of the flat-surfaced "buckets" on top of each other, it is possible to roll the top one back when it is loaded, leaving room for more earth on the next one. This idea was never developed, and he bought it back ten years later for $5,000. Now it is the basis for an experimental 60-yard scraper.

These outfits, like many of those built today, were made to work with Caterpillar tractors. The Tournapull came later. This is a tractor unit consisting of two huge tires on a big axle, with an engine poised between, sticking out in front like a great snout. Detached from a trailer, the Tournapull falls on its nose unless supported by a dolly. It is built for high speed and concentrated traction weight on its two wheels.

One thing LeTourneau couldn't weld for himself was tires. Soon he was having trouble getting them big enough, and that is still a difficulty, though the biggest tires in the world have been built for him. The first tires he used were 13½ by 20 inches. The newest LeTourneau tires, built by Firestone, are 36 by 40 inches, and weigh 3,600 pounds. They are 34-ply, about six inches thick, the tread a yard wide and wheel diameter about 9½ feet. One of them with tube costs $5,000, but they are worth it for they make possible bigger machines. A 45-yard scraper with Tournapull costs about $50,000, of which 40 percent is for rubber.

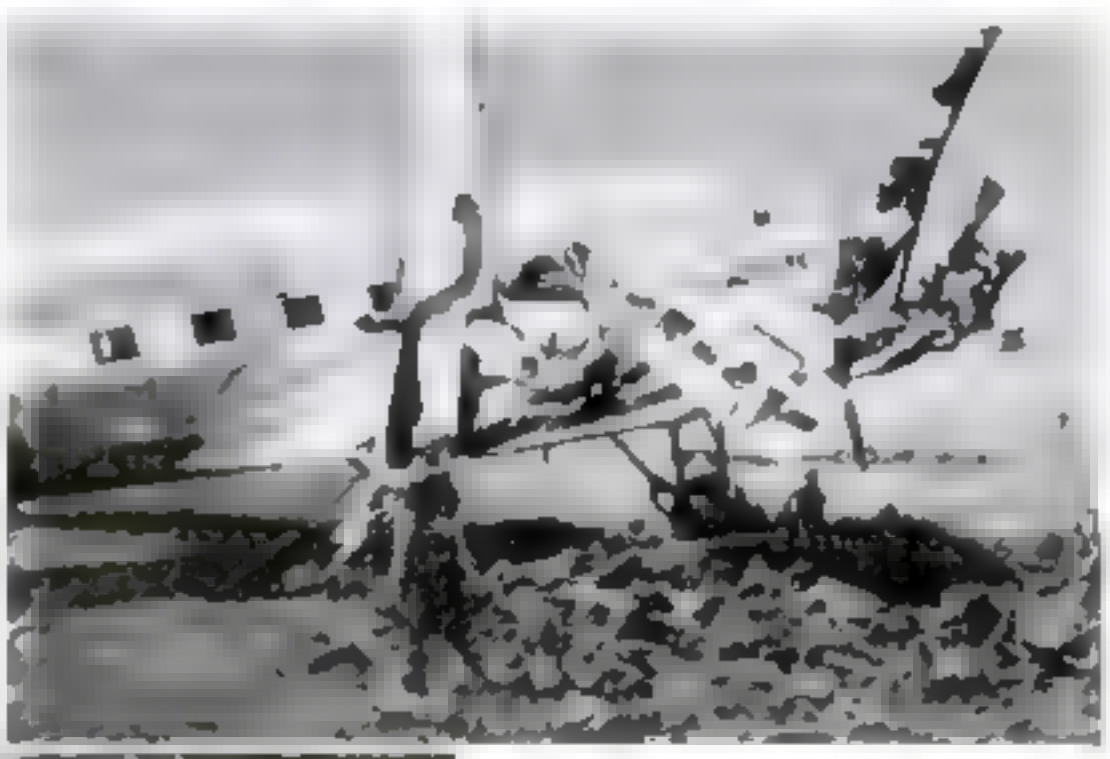
Out at Stockton in the 1920's, LeTourneau's welding shop grew bigger than his contracting business, as he built scrapers, bulldozers, angledozers, sheep-foot drums and other equip- *(Continued on page 220)*

Cap for Officer-Flyers Serves Aground, in Air

U. S. ARMY AIR CORPS officers have solved their headgear problem with a new double-duty cap. A removable wire band fitted inside the soft crown preserves the snappy lines desired for nonflying duty. By removing the wire, officers can clamp earphones over the cap. A flexible leather visor permits it to be folded and packed in a small space.

Off-Size Spare Wing Brought by Air to Patch Bombed Plane

How modern war inspires ingenuity was demonstrated recently at Siufu airport in central China. A Japanese bomb shattered the right wing of a Douglas DC-3 transport. The only spare wing in China was a shorter type for DC-2 planes and was 860 miles away, at Hong Kong. Flown to Siufu clamped to the fuselage of another transport, the wing was installed before the Japanese could destroy the crippled ship. It then flew to Hong Kong.



Japanese bombers did this to the Douglas DC-3 passenger transport plane they caught on an air field in central China. One hit out of 200 bombs wrecked the right wing

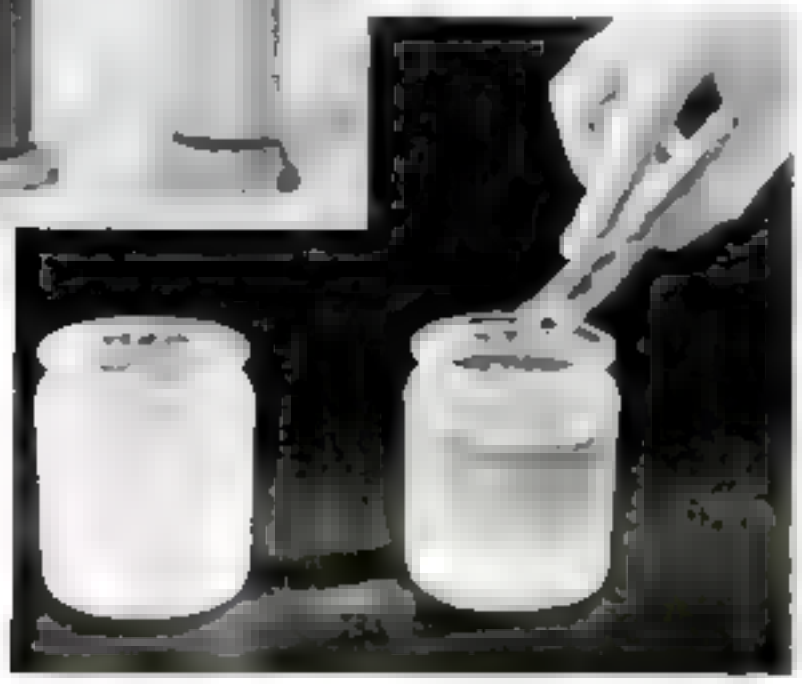
Here is the crippled ship fitted with a spare wing for the smaller DC-2. The Chinese characters on the wings, translated "Middle Kingdom Space Machine Family," stand for China National Aviation Corporation, operated by Pan American Airways in coöperation with the Chinese Government

Used dissolved in water, trisodium phosphate removes grease and dirt from the hands of mechanics. It will not hurt scratches and cuts; in fact, it hastens healing

Soapless Soap

TSP...A CHEMICAL CLEANER WITH MORE THAN 1,000 USES

TSP softens water and emulsifies oil and grease so that they may be washed away. Oil floats on colored water in the far test tube at left, but TSP holds it suspended at right. Below, it precipitates calcium carbonate, a water hardener



DO YOU know a chemical that will soften water, wash dishes and clothes, scour porcelain, clean a car radiator, degrease the engine, remove paint from brushes and woodwork, heal cuts, and save money in your heating system?

Factories, laundries, hotels, dairies, garages, have employed its magic for years. You, too, have used it as a mysterious ingredient in some of the several hundred cleaning preparations that contain it. Get acquainted with the pure chemical, learn its amazing utility, and you will rate it a household necessity.

Trisodium phosphate—or TSP, as it is known to industry—is a white powder that dissolves completely in hot or cold water, differing from soap in that it makes no suds and leaves no scum. It cleans because it emulsifies oil and grease-binding dirt—breaks them down into particles which plain water can wash away.

Besides being versatile and effective, TSP is also economical. In hundred-pound lots it costs five or six cents a pound, in single pounds about 15 cents. One pound goes as far as eight to 16 of ordinary soap.

One teaspoonful in warm water brings

Cleaning without suds, a little TSP in water makes dishes, glasses, and silver sparkle, and it will leave no greasy scum, difficult to rinse off. Burned food and thick grease are removed by boiling water and TSP in the hard-to-clean utensils

Its antiseptic qualities make trisodium phosphate especially desirable for washing baby bottles and preserve jars. Not only are germs killed, but film in which bacteria might form is also removed

Just a little TSP goes a long way, and so it is economical as a household cleaner. The tiny pile at the left will do the work of the great heap of ordinary soap powder shown at the right

out dishes clean and sparkling without soap. Greasy pans and utensils containing burned food are cleaned by boiling water and a little TSP in them. Aluminum is corroded by alkalis, so wash it with TSP, but do not soak or boil.

Soak cotton and linen overnight in a tub half full of warm water containing two tablespoonfuls of TSP, and the wash is almost done. In the morning add enough soap to make suds. Do not soak wool or silk. One teaspoonful in a pail of tepid water makes windows and mirrors shine. In cleaning canning jars and baby bottles, TSP kills germs and removes film in which bacteria might grow.

Two teaspoonfuls in a pail of warm water cleans paint. A little stronger or hotter solution removes high gloss. A pound in a gallon, applied with a brush, softens paint for scraping, and cleans hard paint brushes.

Scum on wash bowls, sinks, and bathtubs is undissolved grease or soap insoluble in hard water. TSP on a wet cloth will remove it. The chemical will not harm porcelain, but it should not be used to scour other finishes. Expensive bath salts may be colored and scented TSP crystals. A tablespoonful of that used for general cleaning does the identical water-softening trick.

By electrolysis, a half teaspoonful of TSP and a quart of hot water in an aluminum pan will free silverware from tarnish in two minutes, with less wear than polishing. Afterwards the silver should be rinsed.

TSP is invaluable for removing grease from motors, engines, and mechanical parts, and from the hands. For the former, use an ounce in a pail of water; for the hands, use four ounces in a gallon as liquid soap. Put

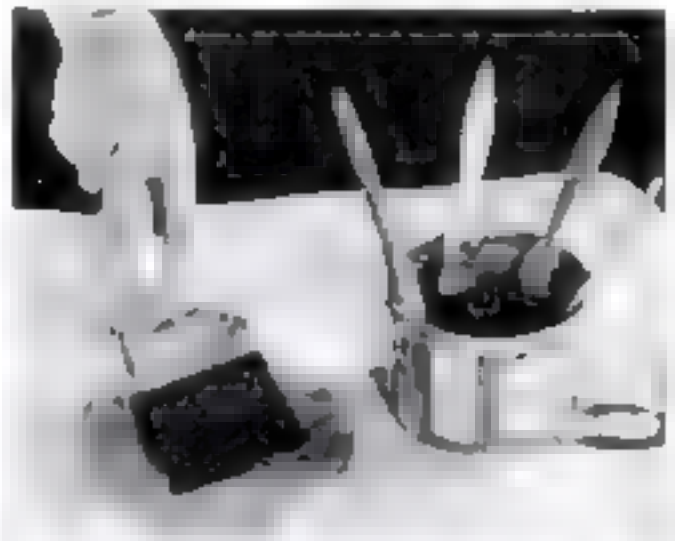
Painted woodwork can be cleaned quickly with a mild, tepid solution of TSP in water. Wet down the paint and dry it off with a soft cloth. A stronger solution used hot will soften paint for removal with a scraper, and will not raise the grain of the wood as would caustic soda

five ounces in a clogged car radiator, engine running; use the car for several days, and then drain, being careful of the paint.

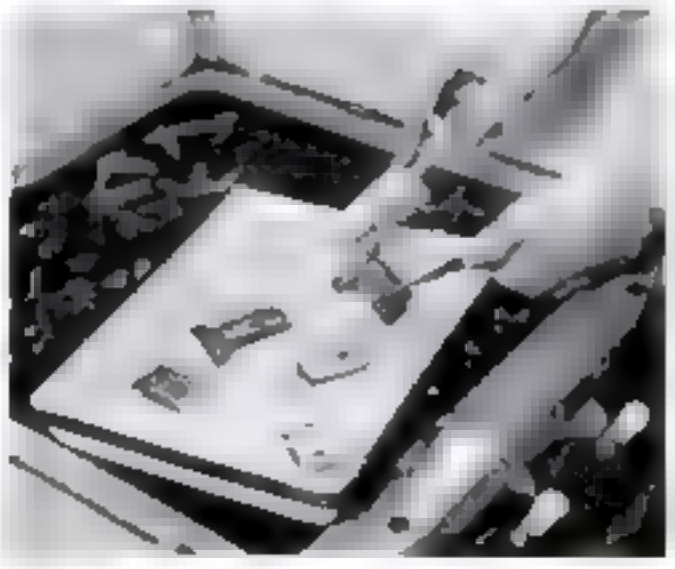
TSP in your furnace boiler will soften the water, prevent scaling, and save possibly a ton of coal a year. Ten ounces should do for the winter.

Finally, being antiseptic, TSP will help prevent infection and hasten healing of cuts.

Silverware, laid out at the bottom of an old aluminum pan and completely covered by a hot TSP solution, loses its tarnish in two minutes. A pound of the chemical in a gallon of water will clean paint brushes, as at right, even if they are dry

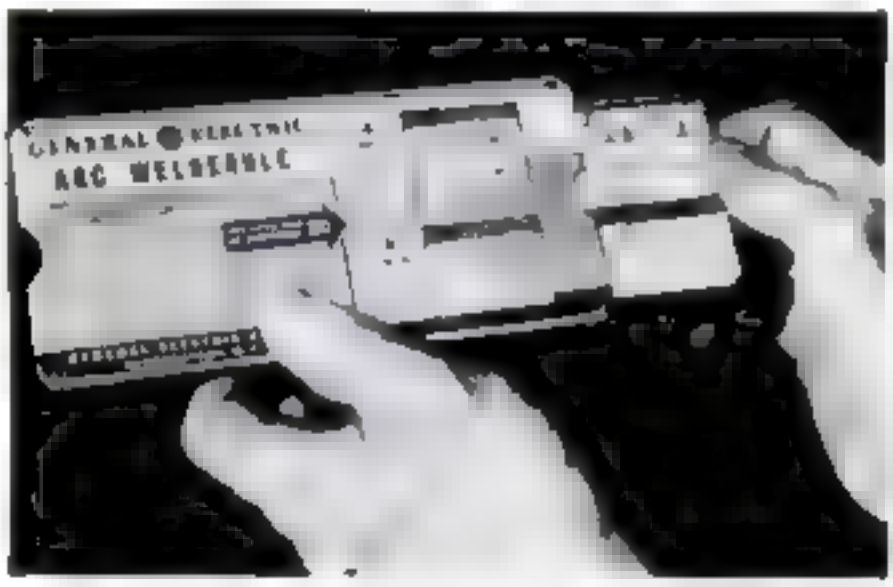


Half a pound of TSP, put in the radiator and circulated through the cooling system of an auto for several days, does a thorough cleaning job. Used boiling, TSP loosens the silver deposit on developing trays and other photographic equipment so that it can be brushed away

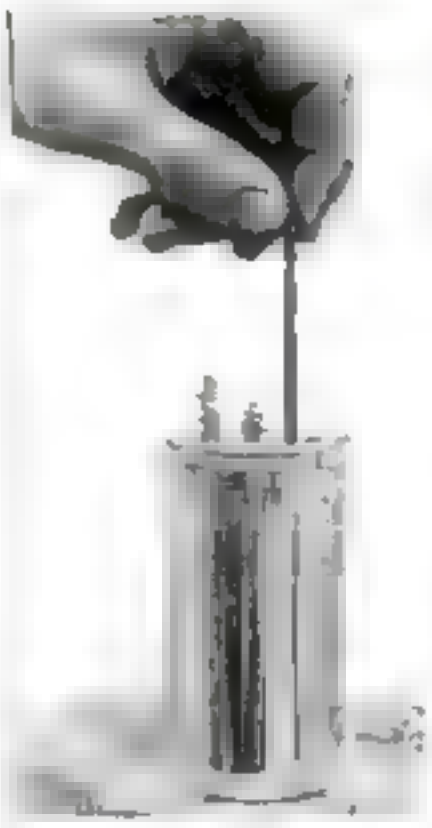


New Tools

OPERATED ENTIRELY BY FOOT CONTROL, the hydraulic vise at right holds work in place with any force up to five tons, for press operations, punching, bending, cutting, straightening, and stamping. Since the operator has both hands free, he can handle exceptionally heavy work and attain a degree of precision previously considered impossible. Stepping on one of the device's three pedals closes a movable jaw against the work. A second pedal applies the desired pressure to hold the work, while a third one releases the jaw. Special jaw faces can be applied.



USEFUL INFORMATION ON ARC WELDING, hitherto available only in bulletin form, has now been condensed in a handy vest-pocket "slide rule" by General Electric experts. When a user sets a sliding insert to the type and size of electrode, a window shows directly the length of arc-welded joints obtainable per 100 pounds of electrode, together with the pounds of weld metal deposited. The data cover 11 commonly used sizes and types of joints; and 22 different sizes and types of electrodes, in lengths of 14 and 18 inches.



AN AIR-DRIVEN SANDER, developed for garage mechanics and body repairmen, rotates each grain of sand in a 3/16-inch circle at 5,000 cycles a minute. A built-in thumb trigger, shown in use, enables the device to be controlled and operated by the same hand that applies pressure to the work. All operating parts are inclosed in rubber.

DEVISED BY A TOOLMAKER for toolmakers, a compact container provides individual compartments for drills from No. 1 to No. 60. Turning the knurled top enables the user to select the right drill without time-wasting search or "mikeing" for correct

Grasshoppers

. . . THAT'S WHAT THE ARMY CALLS ITS NEW ODD-JOB PLANES

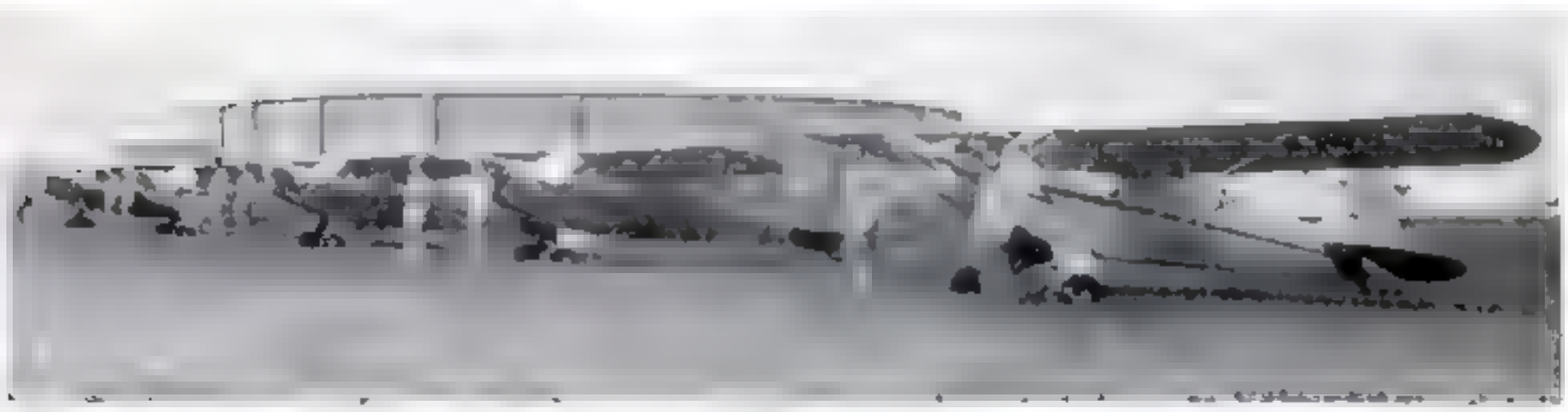
THE latest innovation in Army airplanes is not a fast pursuit or a heavy bomber, or anything else you would think of as a military ship. It is that type of light sportsman's plane which, in bright hues of yellow, blue, or red, has swarmed so increasingly around the pasture-lot flying fields in recent years—our familiar friends the Piper Cub, the Taylorcraft, and the Aeronca.

The Army calls it a grasshopper, and it is simply the stock-model tandem trainer of these common commercial planes. In its own way the grasshopper is almost as exciting and useful a military newcomer as the bantam car, the jeep, has been. This flying jeep won its spurs with the cavalry last summer, and then in the autumn gave such service with the artillery and the infantry that it now seems to be slated for permanent enlistment in the armed forces of the United States.

Its use is for command-control message carrying, observation, traffic direction, taxi, and general-utility work—directly with troops, behind the lines, wherever there is a little field or open road for landing, where bullets are not flying.

It is already in mass production, commercially. This growing industry made 6,000 planes in 1940, and says this figure can easily be doubled. Almost any enlisted man

The lightplane's in the Army now: Ships of this type, designed for private flyers, have proved their value for work behind the lines. Below is part of a squadron leased for use in maneuvers, lined up on a Louisiana schoolyard



With its narrow wing spread, the grasshopper can land on a country road and even roll up to the gasoline pump at a crossroads store to refuel. About 375 feet of unobstructed runway is enough. For "contact," the pilot spins the prop with one hand and operates cockpit controls with the other

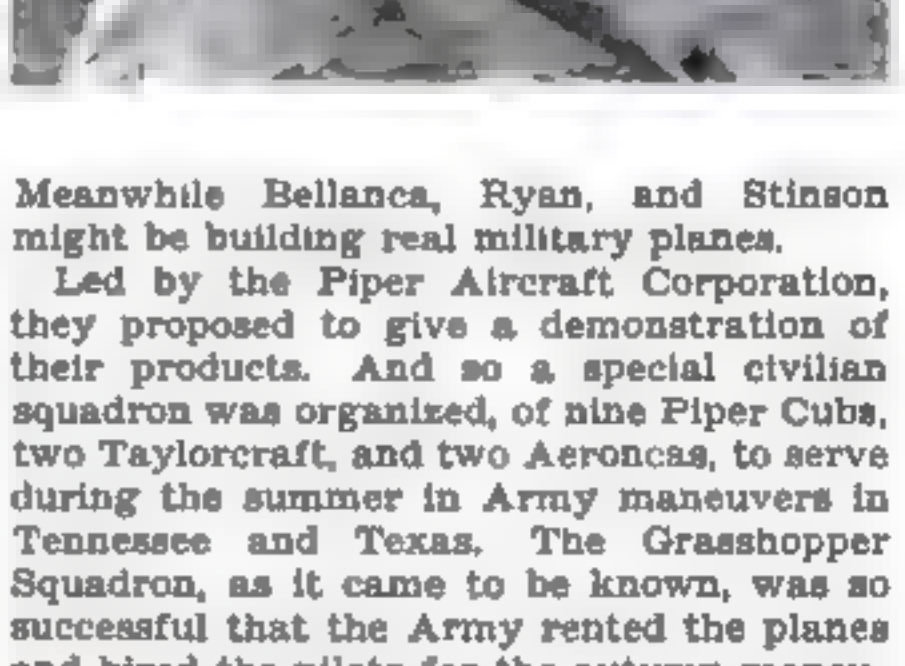
can be trained to fly one in a few hours, and thousands of qualified pilots are in the Army already.

Striking power is only one of the things a general has to worry about. Today's army units move so fast, maps change so rapidly, that it becomes a major problem for the commanding officer to know where his troops are—even before they have reached the zone of combat. Roads and radio channels become jammed and bogged.

One obvious answer to this is the light liaison airplane, able to take off and land on a pocket handkerchief, able to fly so slow and so low that messages and orders can be shouted to troops on the ground—a hedge-hopping plane for the Army's back yard. Such a plane would be of little use on an actual battlefield, for it can easily be knocked down by small-arms fire, but for work behind the lines it is invaluable.

Three specially designed planes of this type, built by Bellanca, Ryan, and Stinson to embody principles developed in Germany, were put into service with the Army this year, and quickly showed their usefulness. With large wings, equipped with flaps and slots to increase buoyancy at low speed, these liaison-observation planes can perform marvels—land and take off in about 250 feet, maintain flight at little more than 20 miles per hour. Against a brisk breeze they can hover, almost stationary, over one spot.

But hardly had these special jobs made their debut when they ran into competition. The small-plane manufacturers bobbed up with the audacious notion that their little stock models could do the same job just about as well—and could be delivered, complete with two-way radio, for less than one tenth of the cost.



Meanwhile Bellanca, Ryan, and Stinson might be building real military planes.

Led by the Piper Aircraft Corporation, they proposed to give a demonstration of their products. And so a special civilian squadron was organized, of nine Piper Cubs, two Taylorcraft, and two Aeroncas, to serve during the summer in Army maneuvers in Tennessee and Texas. The Grasshopper Squadron, as it came to be known, was so successful that the Army rented the planes and hired the pilots for the autumn maneuvers in Louisiana. Meanwhile the Air Corps purchased a number of the planes for testing.

The cavalry maneuvers in Texas were in rough sand-dune country, covered with an eruption of hummocks and hillocks. But a single bulldozer, in 2½ hours' work, had cleared a landing field good enough for the grasshoppers. One of the lightplanes washed out its landing gear on a sand dune. It was back in the air again in an hour and 20 minutes, at cost of $20 for repairs.

Grasshopper Squadron insignia pin

The field-base equipment of the Grasshopper Squadron was so simple that it

"Repair shop" for a whole squadron of grasshoppers is a tool box little larger than a dinner pail, and a couple of boxes of parts

was almost ridiculous. It consisted of a tent, a small blackboard for an operations chart, a couple of boxes of spare parts, and a poker table. The ground crew consisted of one mechanic, whose entire tool kit was about the dimensions of a man-size dinner pail. It needed no supply train for aviation gasoline; it poured in its fuel from a five-gallon can, the same gas that was used for driving the Army trucks

The squadron got its name in a tense moment of maneuvers one day when Maj. Gen. Innis P. Swift, commanding the 1st Cavalry Division, suddenly was seized with an urgent desire to see more of his terrain than was apparent from a staff car or the back of a horse, or from the somewhat fragmentary radio messages that were coming in.

"Get me one of those grasshoppers!" cried the general. And within a few minutes he had it, from the squadron's near-by flying base. And the squadron men did not neglect to notice that an Army radio message, notifying the general that the plane was on the way, did not arrive until 20 minutes after the plane was on the job

The general's happy description of the little planes was immediately taken up by

Field-base equipment is simplicity itself Fuel (the same gasoline that Army trucks use) comes from a drum and is put into the 12-gallon tanks from a five-gallon can. A small blackboard serves as an operations board and a poker table as an operations desk. A bulldozer can clear an adequate landing field in just about two hours' work

the flyers themselves. They painted green grasshoppers on their fuselages. They had pins made up, showing a comic little green grasshopper in a silk hat.

One of the proudest wearers of this Grasshopper Squadron insignia is Lieut. Col. T. H. Kerschner, assistant chief of operations, G-3, Third Army. Both as chief umpire and chief of operations during Army maneuvers, he used a grasshopper plane continually. Often he completed an errand in a few hours, which otherwise would have taken all day, blocked in crowded roads or slogging around in mudholes.

The piney woods country of Louisiana is sparsely populated wilderness, but here and there on the gravel country roads is an isolated store, with a stock mainly composed of canned goods, candy bars, soft drinks, chewing tobacco, and snuff. More than one backwoods proprietor of such an emporium was startled during August and September, by the apparition of an airplane outside his front door by the gasoline pump. It was just Colonel Kerschner stopping to refuel!

Almost every officer who has used a grasshopper or seen it in operation is an enthusiast for it. One Air Corps lieutenant put it this way.

"I've been flying a Stinson O-49, the new liaison plane, and it is a sweet plane at the job it was designed for. But the grasshopper can do almost anything the O-49 can do, and more besides. I can fly a little faster and a little slower, and the grasshopper needs about half again as much distance for landing and take-off. But it doesn't need to land in a small field, because it can land on a narrow road. Its wing spread is only 37 feet. Mine is 51 feet, which is a lot of difference when you're figuring on the width of a road.

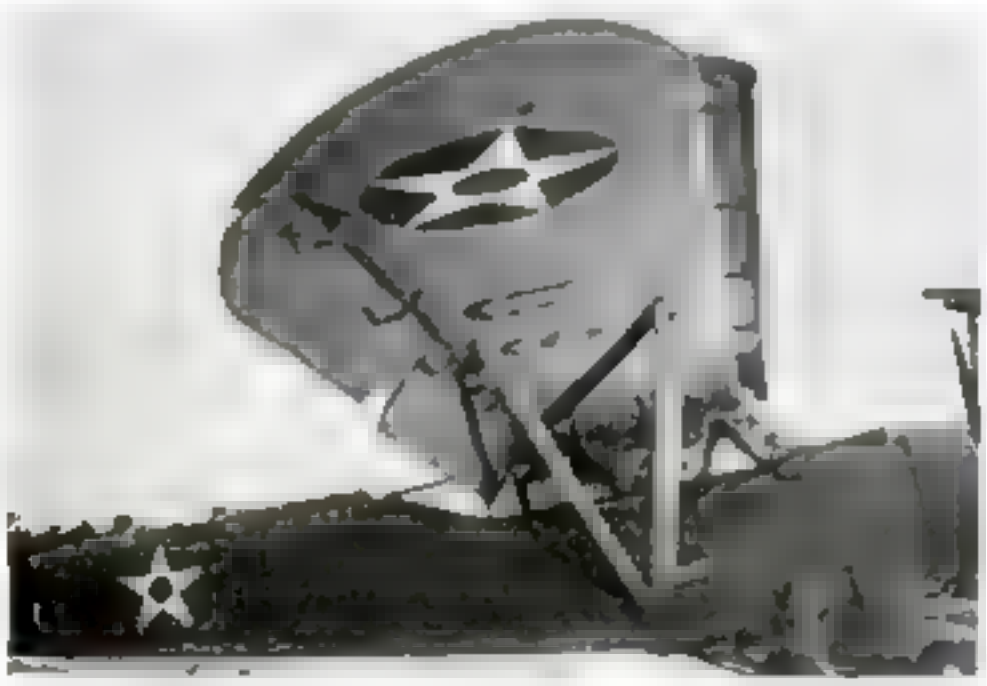
"Also, the grasshopper weighs only 800 pounds unloaded. A pilot can land on a road, and drag the plane off to hide it in the bushes, all by himself. You can't do that with an O-49. It weighs nearly four times as much."

A more specific description, drawn up by a proponent of the grasshoppers, is given in an accompanying table. None of this, of course, is to be taken as a knock at the O-49, which was built to high military specifications and has given splendid performance in the tasks assigned it. Lieut. Gen. Walter Kreuger, commanding the Third Army, used one continually during the war games for personal transportation and for watching his troops in the field. With a loudspeaker fastened under a wing, the Provost Marshal

Some Tasks That Lightplanes Can Take Over from the O-49

OBSERVATION is one of the jobs of the Army's regular O-49 light liaison plane. Large wings, with flaps and slots seen at lower left, give it buoyancy at low speed

MESSAGE CARRYING is another task at which the grasshopper may relieve the O-49. Below are shown two types of message pick-up devices; the one on the left is homemade



found an O-49 very useful in directing convoys on congested roads.

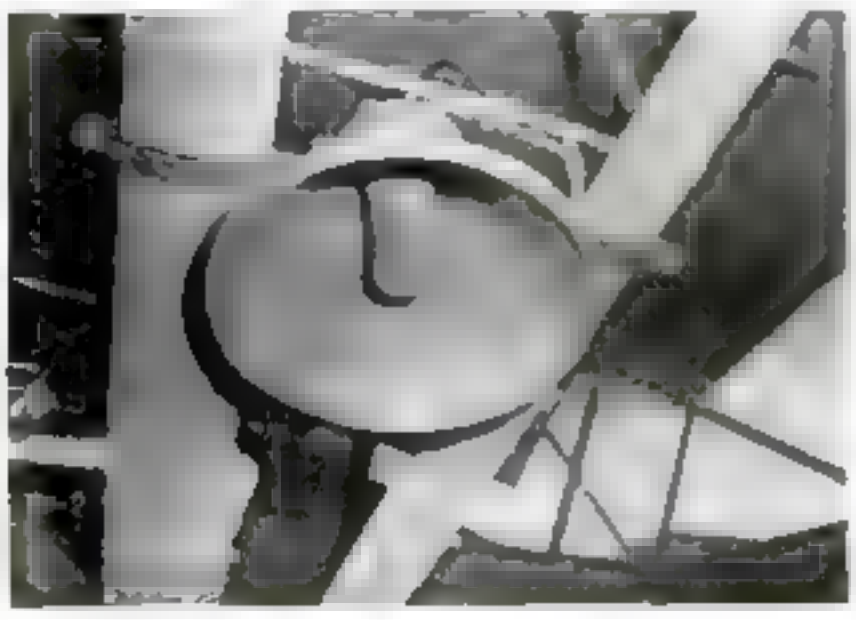
The appearance of the grasshoppers with the Army immediately called forth a flood of letters from selectees with pilot's licenses, who would prefer flying to continuance as infantry privates. One thing that seizes the imagination of enthusiasts about the lightplanes is that it doesn't take much training to fly them. They foresee lightplanes, piloted by noncommissioned officers, operating with ground units, on practically the same basis as a truck or a command car.

But one thing is settled. Ground officers who have worked with grasshoppers want grasshoppers. And when the troops want an item of equipment, in these days, they generally get it.
—HICKMAN POWELL.

TWO-WAY RADIO gives the grasshopper's crew contact with the ground. With this equipment, a lightplane can be delivered to the Army for about one tenth the cost of an O-49

Current for the radio and other electrical equipment is supplied by a wind-driven generator mounted above the landing wheels as seen at the right—another bit of simplified operation

DIRECTING TRAFFIC or giving orders to troops on the ground is accomplished by means of a loudspeaker mounted under the body of the plane. Lightplanes are also well suited for this kind of work



HERE ARE FACTS AND FIGURES ON GRASSHOPPER PERFORMANCE

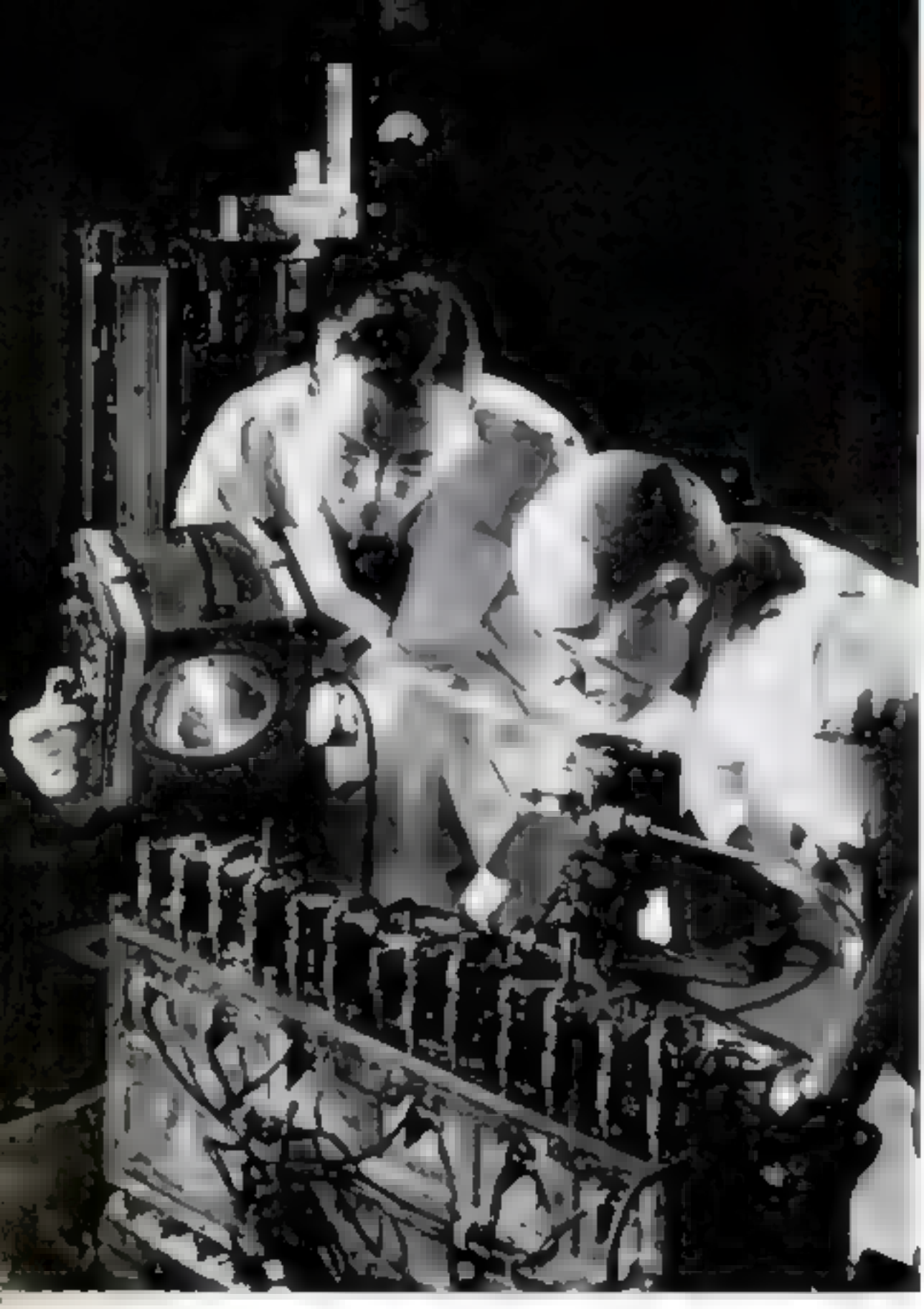
Engine horsepower	65
Gasoline capacity	12 gal.
Gas consumption	4½ gal. per hour
Quality of gas	70-80 octane
Air speed (high)	80 m. p. h.
Air speed (low)	40 m. p. h.
Cruising radius	2¾ hours
Visibility	Good
Radio equipment	Good
Cost with radio	$2,500 (minus)
Weight loaded	1,100 lb.
Seats	2
Combat equipment	None

"STOP LIGHT"

SOLVES INDUSTRY'S PUZZLES

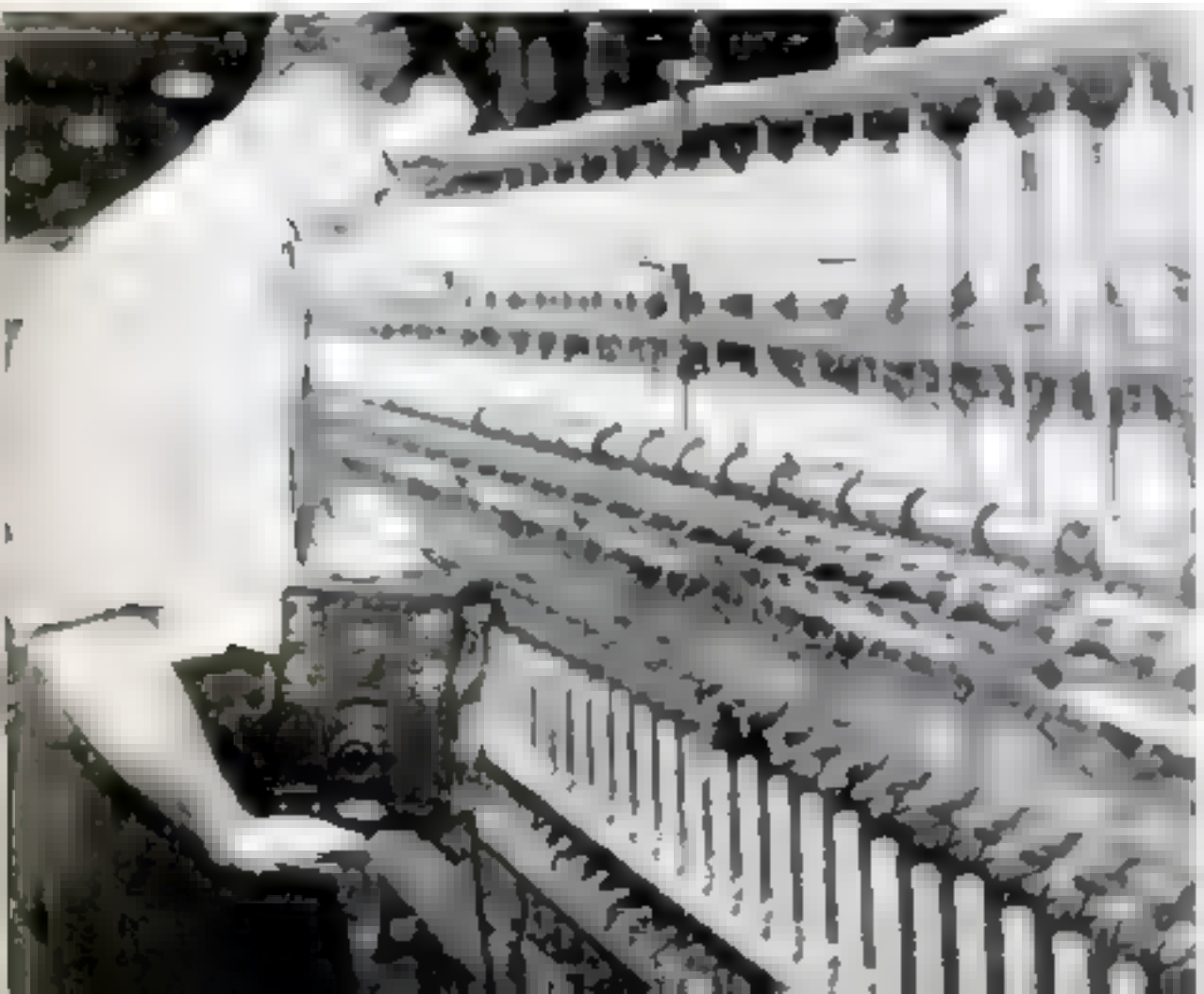
STRANGE lamps that freeze the motion of machines, so that engineers can inspect or improve them, now find application by hundreds of American manufacturers. They serve in tasks as varied as observing springs, textile spindles, electric razors, fans, belt drives, wrist watches, and Diesel engines. But all these uses depend upon one simple principle.

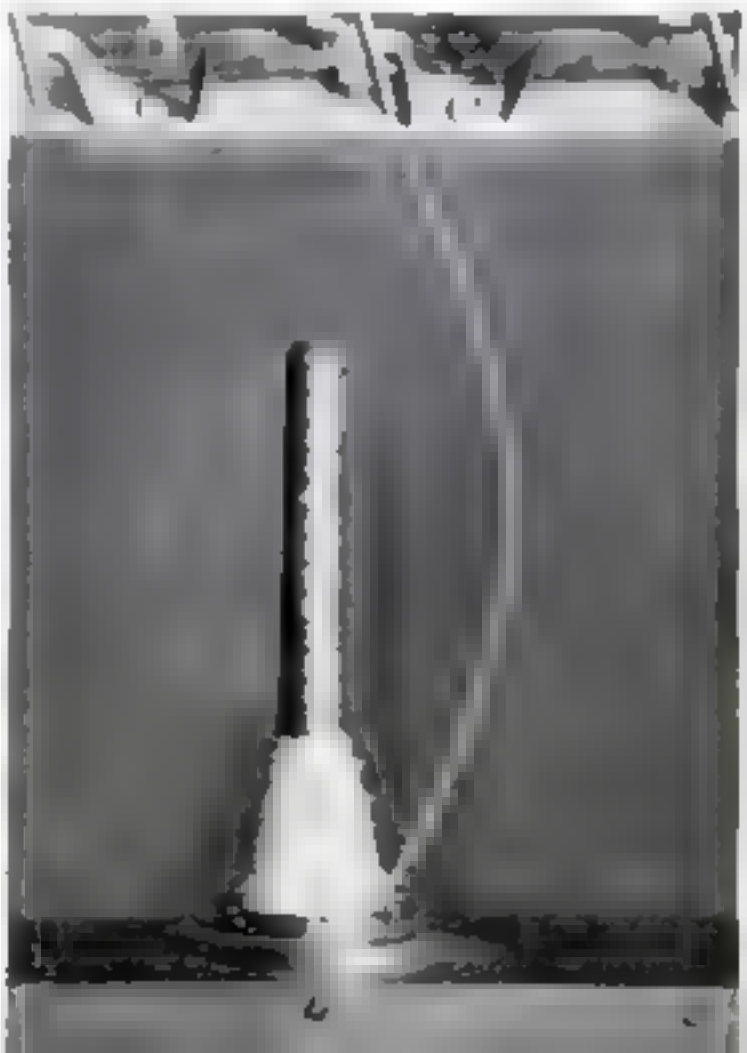
Suppose you flash a lamp at accurately timed intervals for 1/100,000 of a second or less, so that it comes on, each time, just as a blade of a revolving fan reaches the top of its circular path. No matter whether it is the same blade or a dif-



Engineers studying the action of the valve mechanism of an engine with the aid of a stroboscopic lamp whose flashes may be adjusted to slow down periodic motions visually, or stop them altogether

Below is a stop-motion view of yarn on a textile-mill spindle. By setting his lamp to "freeze" the spindles at a given speed, an inspector can check a whole row for uniform speed as shown at the left





ferent one, the fan appears to be standing still. With the aid of this stroboscopic lamp, an engineer can watch or photograph any periodically moving parts in a machine running at full speed. Depending on the rate at which his lamp is adjusted to flash, the machinery may be observed in "slow motion" or brought to a dead stop as desired.

In one "frozen-motion" application, flickering lamps now stop cloth running through a printing machine as fast as 474 yards a minute, so that the operator can check the registry of colors in the design—and, if necessary, shut off the machine in time to avert waste of a costly fabric.

To see that spindles in a textile mill operate at uniform speeds, an inspector adjusts his "stop light" until one spindle stands still. Then he walks down the row of them, turning the light on each. Any that fail to be stopped are running too fast or too slowly. The adjusting knob of the lamp also reads directly in revolutions per minute, so that the speed of a revolving part may be measured by optically "stopping" it.

Photos reproduced by courtesy of General Radio Co., Westor Rich Division, Eaton Mfg Co., The Hoover Co., General Electric Co.

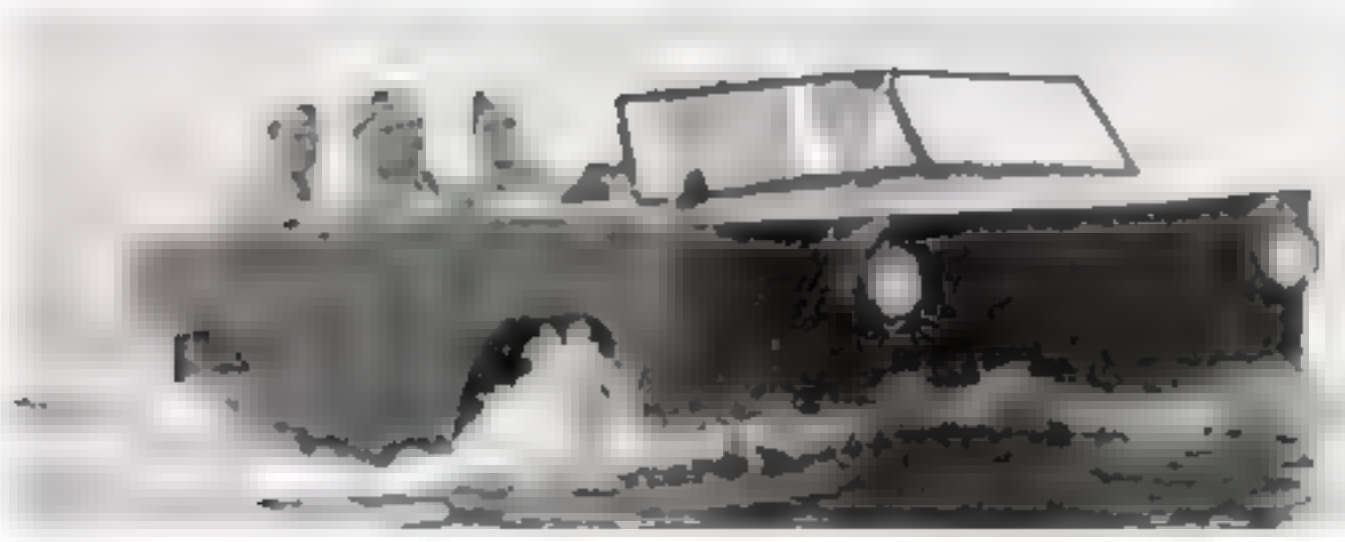
Smoke patterns reveal air currents around the moving blades of an electric fan. Studies of this type, made with the stroboscopic lamp, help engineers in designing efficient blades

Below, cloth in motion on an eight-color printing machine is "stopped" between two General Electric stroboscopic lamps so an operator can check on registry of colors

This photo shows how the fabric blades on an electric fan are held out at the most effective angle by centrifugal force

Caught in the act: two helical springs in an experimental shaft coupling are interfering with each other

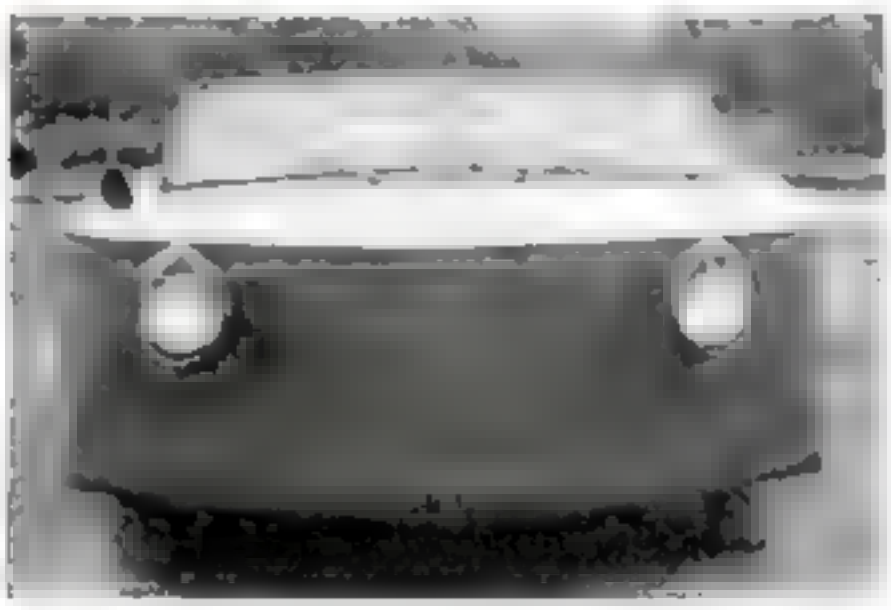
Armored Amphibian Army Truck Needs No Bridges



In the water, this new lightly armored vehicle supports a heavy load and goes on its own power

. . . while ashore it looks like this. It is intended for use by officers in bridgeless country

WATER barriers mean nothing to a new amphibian truck which has been developed for use of officers in the U. S. Army. The lightly armored land-and-water machine has been designed to provide rapid personnel transportation in country where bridges are infrequent or have been destroyed. Arriving at the bank of a stream, or the shore of a bay, the truck rolls down into the water, floats even when carrying a full load, plows ahead under its own power, and, on reaching the opposite bank or shore, climbs out and proceeds again as a land vehicle.



Paper Tester "Spends" Money to See How Far It Will Go

MAKING money last longer is the purpose of a new testing machine developed for the Bureau of Engraving and Printing, in Washington, D. C. Replacement of worn-out bills costs millions of dollars a year. By giving paper money, in a few minutes, as much folding and crumpling as it would receive in months of normal service, the apparatus shows which types of paper will wear longest in actual use in the pockets and purses of the nation.

Hybrid Vegetable Is a Cross Between Celery and Lettuce

CELTUCE, a new vegetable combining the uses and flavors of celery and lettuce, is announced by David Burpee, president of a leading American seed-growing firm. Raw stalks may be peeled, halved, or quartered, and eaten like celery. When cooked, the pale-green stalks or cut pieces make an attractive hot or cold dish. Leaves of young plants may be used like lettuce or cooked as greens. Celtuce, according to its creators, may easily be grown in home gardens, and is suitable for marketing and shipping. Stalks of the hybrid vegetable are seen in the photograph at the right.

An American howitzer tilts its nose at its invisible target—an enemy gun position whose location has been revealed by spreading concentric circles of sound waves picked up by a row of microphones

From an advanced outpost, an observer hears the report of the enemy gun. By remote control he starts an oscillograph to record sound waves as they hit the mikes

SENSITIVE MICROPHONES SPOT HIDDEN GUNS

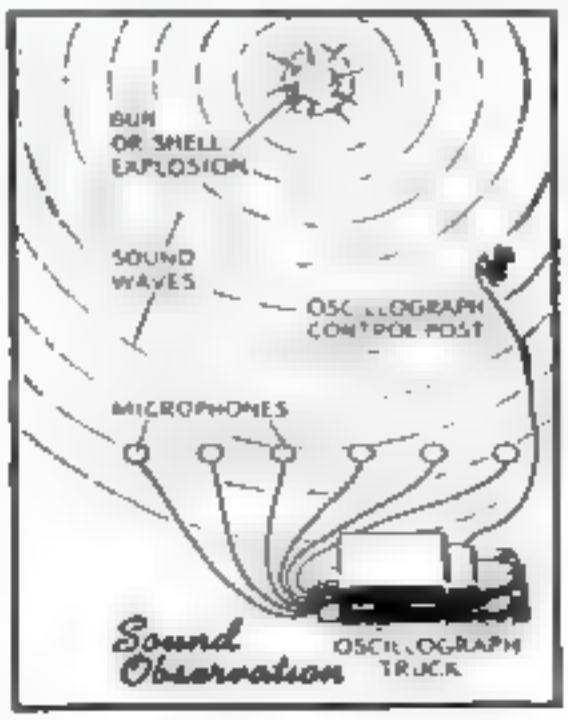
A DARK NIGHT of impenetrable fog. The enemy's heavy artillery has found the range and is blasting away, even its flashes invisible. Death hurtles in from an unknown source.

The enemy shells cause terrific havoc, but not for long. This situation is duck soup for the Observation Battalion attached to the artillery of each American army corps. Within a few minutes, simply by calculations from sound waves, it has located the enemy battery and American guns return the fire with deadly accuracy. Similarly, by listening for the bursts of friendly shells, the sound-observation platoon can check the precision of the American fire.

Improved since the first World War, the technique of sound observation is based on the fact that sound waves, in still air at 50 degrees Fahrenheit, travel 369.2 yards per second. By placing low-frequency microphones along a surveyed base (which may be as much as 10,000 yards long) it is possible to measure the differences in time required for an expanding circle of sound waves to reach the various microphones. From these are calculated the gun's location.

Corrections must be made for speed and velocity of wind and for temperature, up to several hundred feet above the earth; and accuracy depends on the skill with which the battalion's meteorological section measures these factors. The best time for sound observation is a foggy night.

When conditions are unfavorable, the Observation Battalion must depend entirely on the older system of observing the flashes of enemy guns, from widely separated points, and taking bearings on them. Used in combination, the two methods provide a detection system which puts any enemy gun in peril within a few minutes.



It takes several hours to install an accurately surveyed sound base. At each of six equidistant points is placed a microphone, which looks like a large tin can, is acoustically resonant, and is so constructed as

SOUND OBSERVATION. As sound waves strike the various microphones, they create impulses that are recorded separately on the oscillograph. By measuring the minute differences in time, observers can calculate the approximate location of the sound's source

To gauge wind velocity and direction for sound observation, men of the meteorological section follow pilot balloons with theodolites. At night, balloons carry lights resembling Japanese lanterns

to cut out high frequencies such as machine-gun fire.

All the microphones are electrically connected to an oscillograph at the headquarters of the sound-observation platoon, which records the impulses on a moving strip of photographic film marked off into fractional units of a second. Silence appears on the film as six parallel lines; then as the sound waves hit the mikes, each line "breaks" into vibration at a different instant.

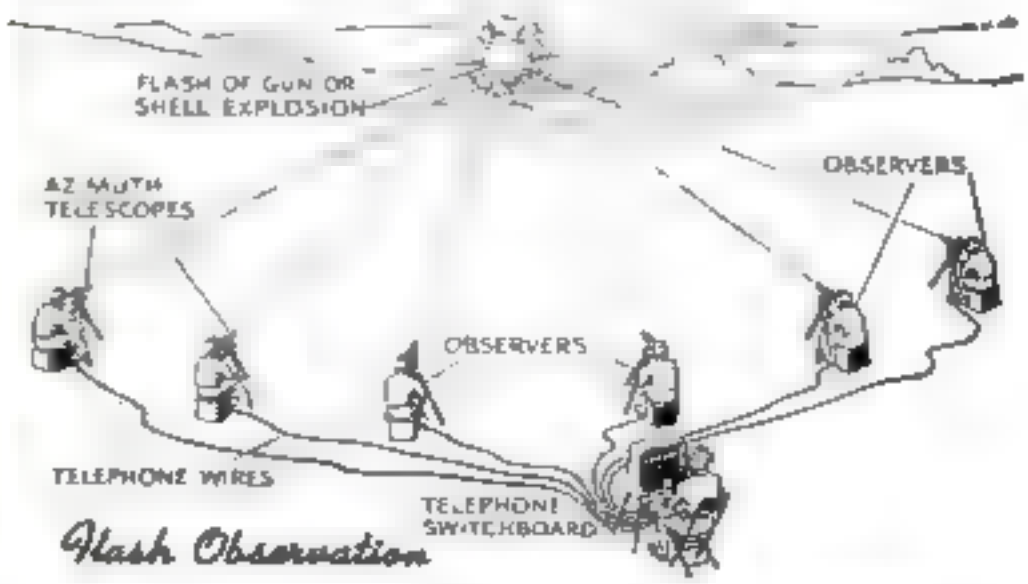
Amid the thunder of an artillery battle, isolation of a single gun's sound is important. The microphone does much of this by its selectivity. Then in practice the oscillograph is ordinarily started by an outpost observer who listens from a point nearer the enemy than any of the mikes. When he hears a gun he wishes to locate, he presses a button and the film is running by the time the sound waves reach the mikes.

Flash observation is more a matter of human skill. Each post has an observer with an azimuth instrument—a telescope which revolves on a circular scale. Each instrument is set identically to Y-North, and angles from that bearing are measured by the artillery mil—1/6,400 of a circle.

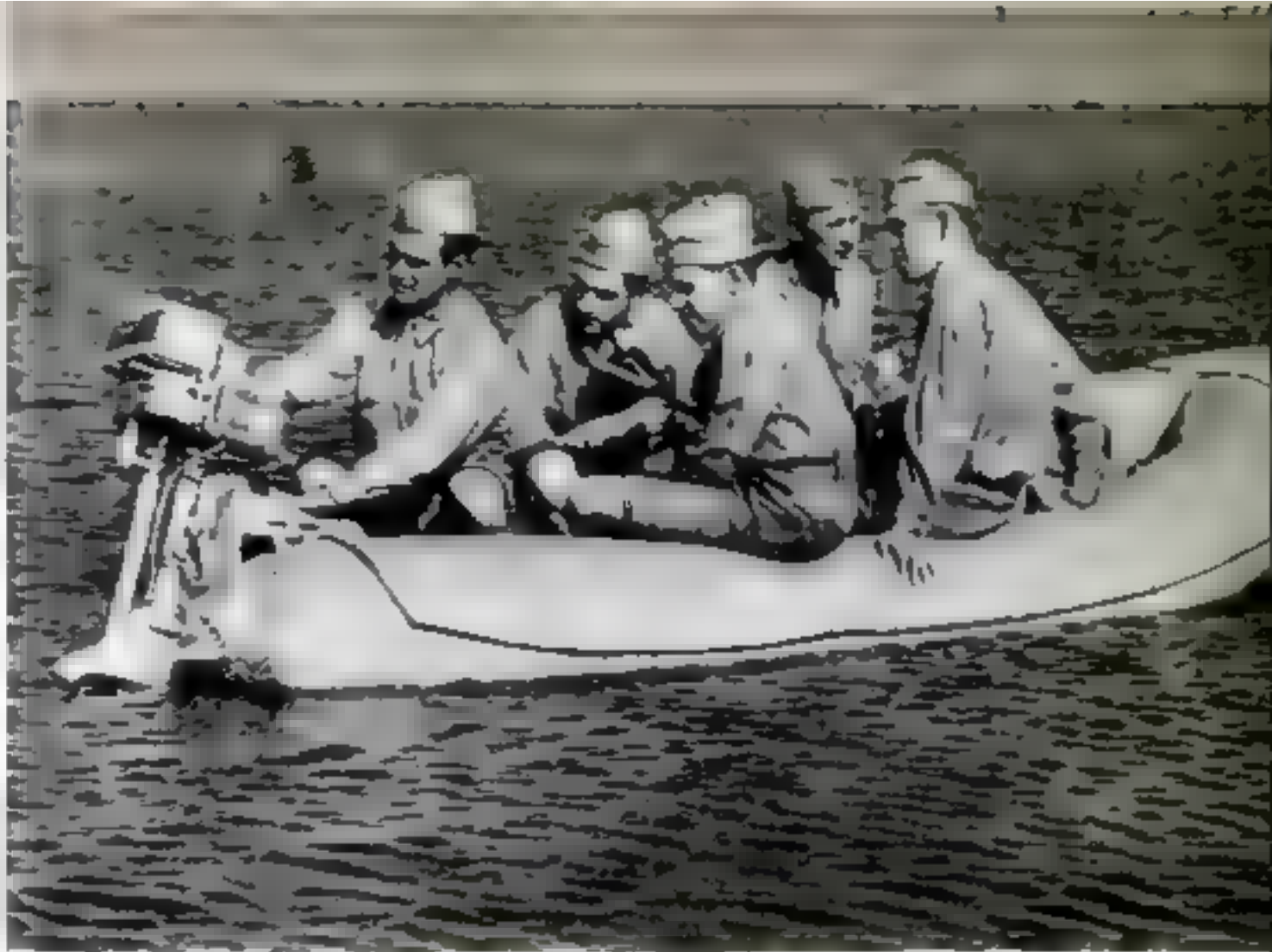
These observers work as a team with a switchboard operator to take bearings simultaneously on a single gun. Isolating a flash, the observer presses a button which flashes a light on the switchboard. When two or more lights flash at the same instant, it means the observers are watching the same gun. Once the readings have been telephoned to headquarters, the locating of the gun is a simple matter of triangulation, done with a drafting machine. A large-scale map is placed on a revolving board, whose position is measured in mils. As the circular board is moved to the various readings, the azimuths are drawn on the map by a straightedge ruler. Where the azimuth lines cross is the position of the gun.

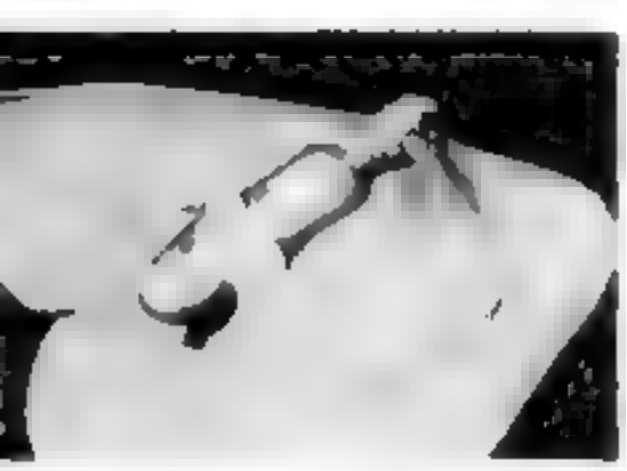
The Observation Battalion is one of the most intensely technical units in the Army field service. Expansion of units has drawn into the job experts ranging from physics professors to seismological specialists from the Texas oil fields.—HICKMAN POWELL.

FLASH OBSERVATION supplements sound observation, and replaces it altogether under certain weather conditions. Observers with azimuth instruments like the one shown at left take bearings simultaneously on the flash of a hostile cannon. Their readings are reported by telephone through a central switchboard at headquarters for plotting. Here a large-scale map on a circular board is turned to match the various readings and bearing lines are drawn with a straightedge ruler. Where these azimuth lines cross is the position of the target



Flash Observation



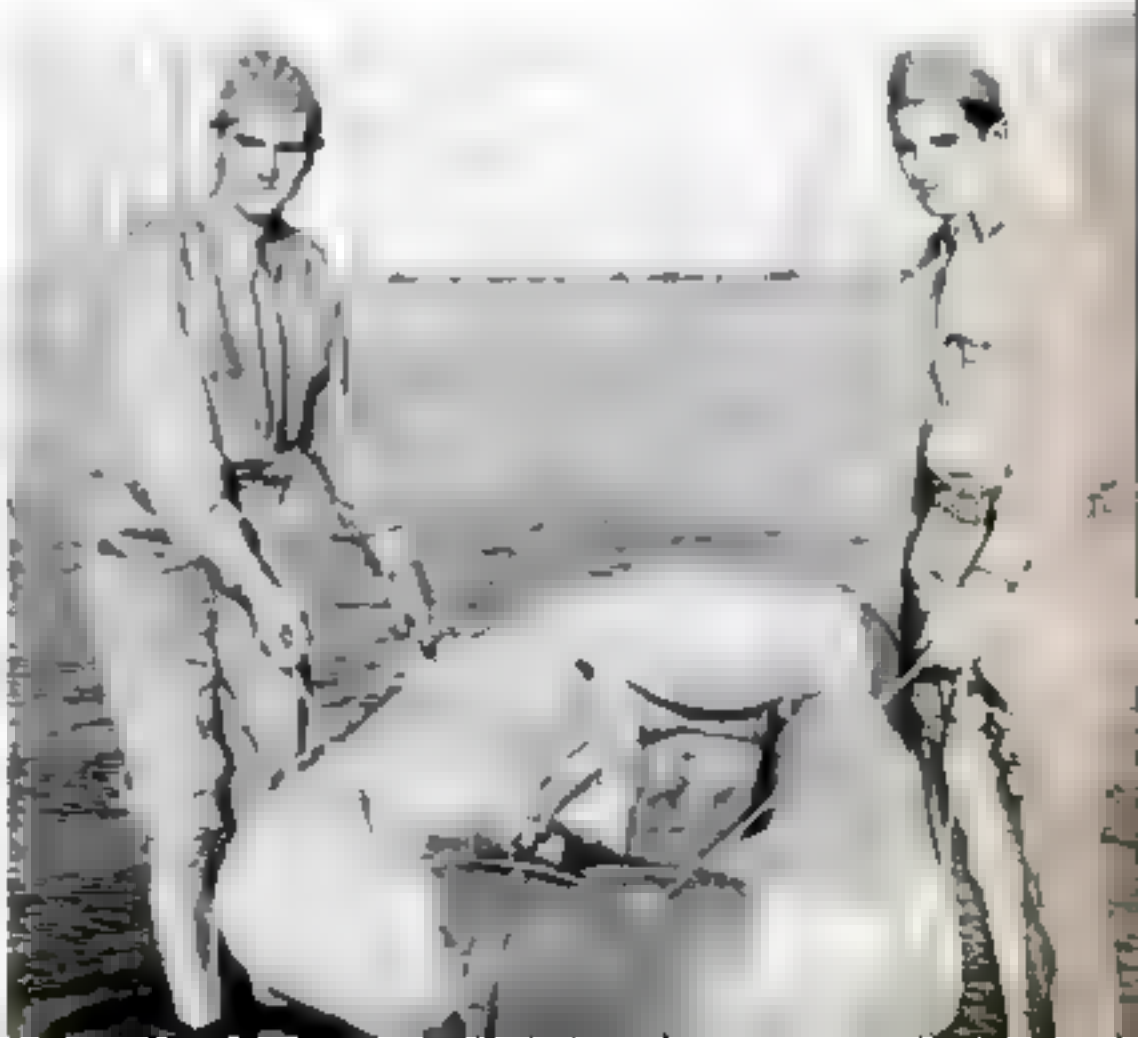


BETTER THAN ROWING: These men are trying out one of the new collapsible boats made by U. S. Rubber for the Navy. Large enough to hold the entire crew of a big bomber, it is powered by an outboard motor that shoves it along at a speed of eight miles an hour. When deflated, the boat makes a light, compact bundle as shown in the picture at upper left. In a forced landing, it is inflated quickly with carbon dioxide from a small metal cylinder by lifting a handle which punctures a leakproof inner container. The bottom of the "doughnut" is sealed by waterproof fabric, and cloth seats provide comfort for the passengers

NAVY BOMBERS CARRY FOLDING MOTORBOATS

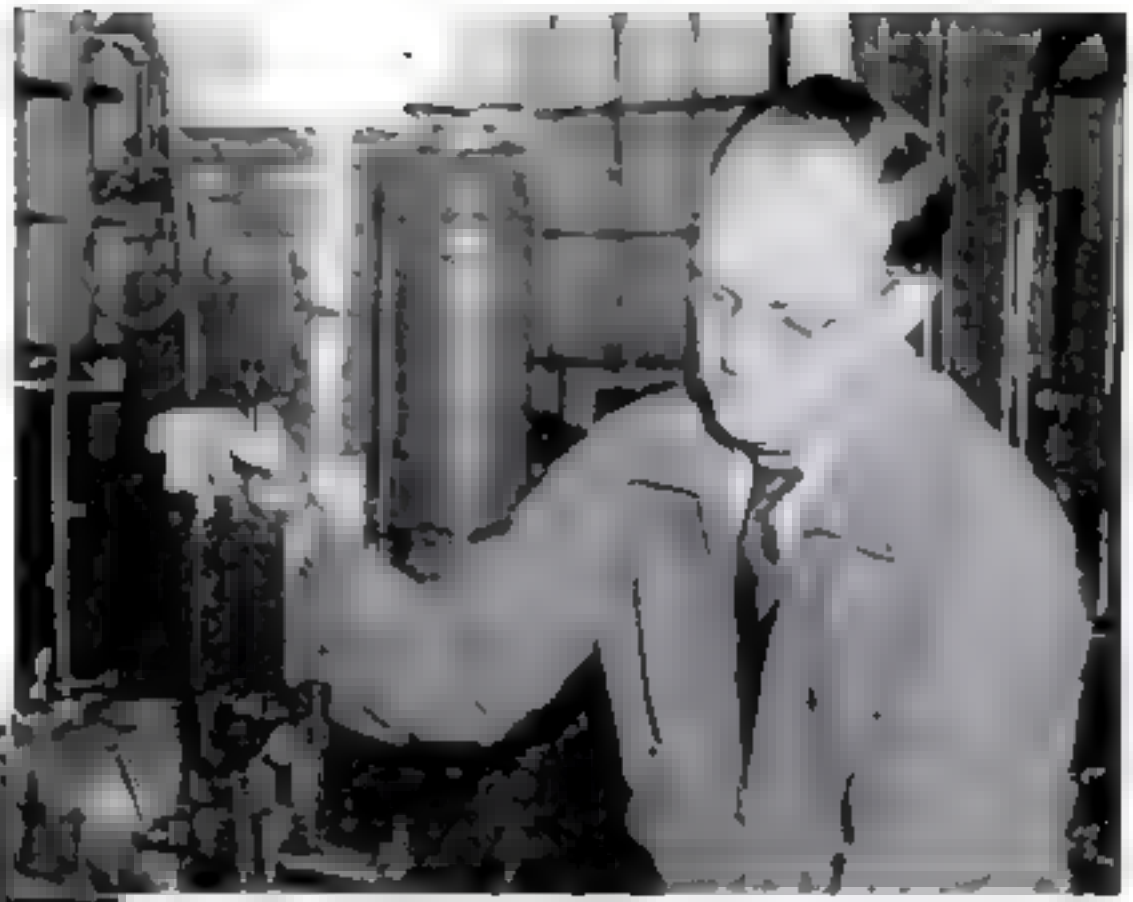
CREWS of U. S. Navy bombers no longer have to row for shore after a landing at sea. The collapsible rubber boats carried by bombers are now equipped with ten-horsepower outboard motors. In two sizes, capable of carrying full crews of four or seven men, the craft will make eight miles an hour. Larger size is 12 feet long.

The boats are intended for use both after forced landings and for ferrying crews ashore at isolated bases. Carbon dioxide compressed in small metal containers is used for inflating them and the outboard motor is clamped to a wooden platform strapped to the stern. Boats for emergency use are painted bright orange, the color the Navy has found easiest to spot at sea. Emergency rations, a signaling reflector, and flares are stored in pockets in the inner walls.

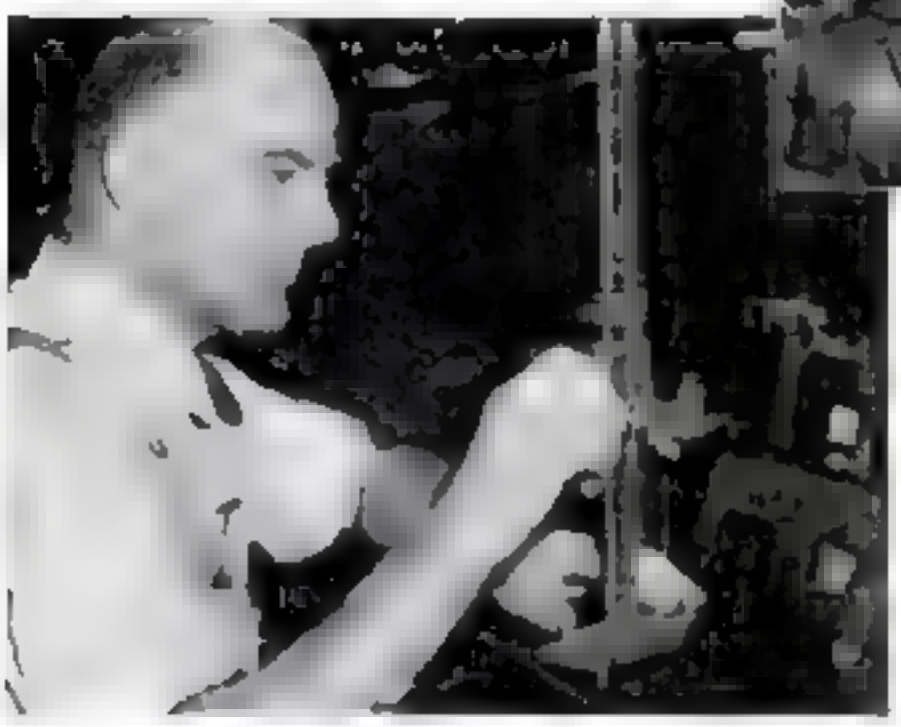


For planes carrying smaller crews, the Navy still uses two-man rubber boats like this. It is inflated like the larger boat, but depends on elbow grease for motive power. Collapsible oars fit into built-in reënforced oarlocks

WORKERS WIN CASH AWARDS FOR DEFENSE IDEAS



F. Gregory, a civilian employee in the U. S. Army arsenal at Watervliet, N.Y., who recently received a $50 award for his suggestion for purchase of standard bushings for drill jigs



William A. Koenig, at left, saved Uncle Sam $3,000 over a short period of time by developing a special tool that makes milling work more economical. A $150 check was his reward

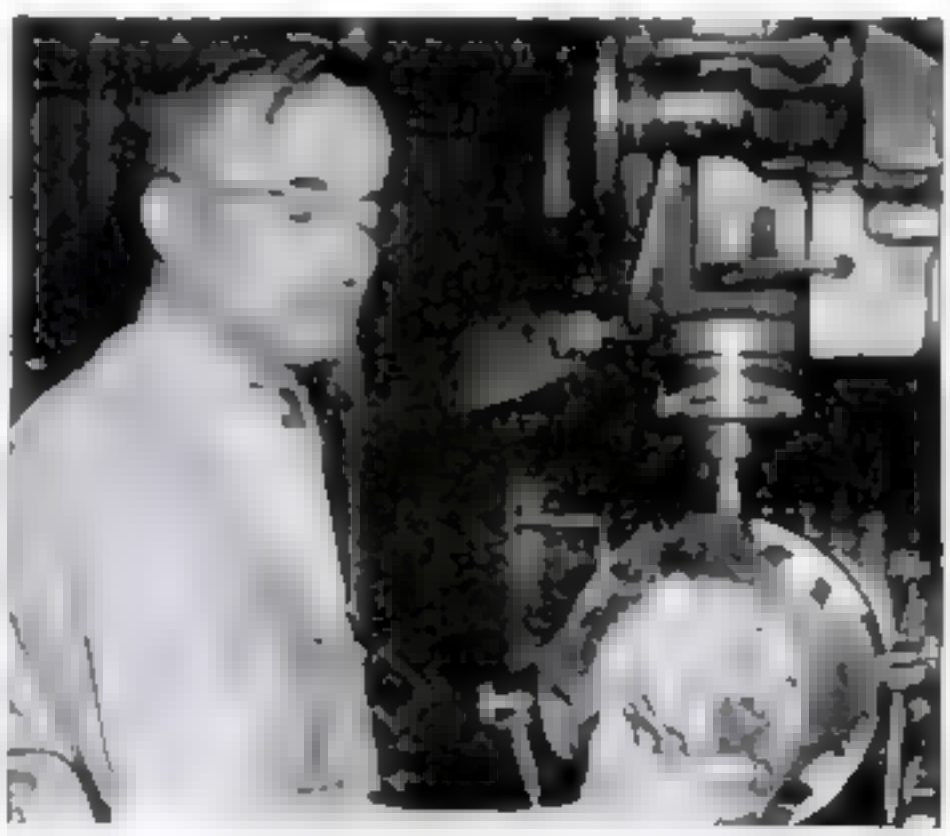
THREE civilian workers at the Watervliet Arsenal, Watervliet, N. Y., have been awarded cash prizes by the U. S. Army Ordnance Department for their ingenious suggestions which have resulted in speeding up national defense and saving the Government money.

William A. Koenig, a machinist, developed a special tool for more economical milling which, in a short time, saved the taxpayers close to $3,000. As a token of appreciation, Uncle Sam presented him with a check for $150.

F. Gregory, another civilian employee at the arsenal, suggested that standard drill bushings be purchased for drill jigs to speed up the work. This suggestion saved the Government $1,000 and drew an award of $50.

William G. Rohrwasser, a toolmaker, suggested a new fixture to compress the ends of wooden pegs that are used in Babbitt reamers which saved the Government $200 a year and lots of valuable time. This idea brought a $20 reward.

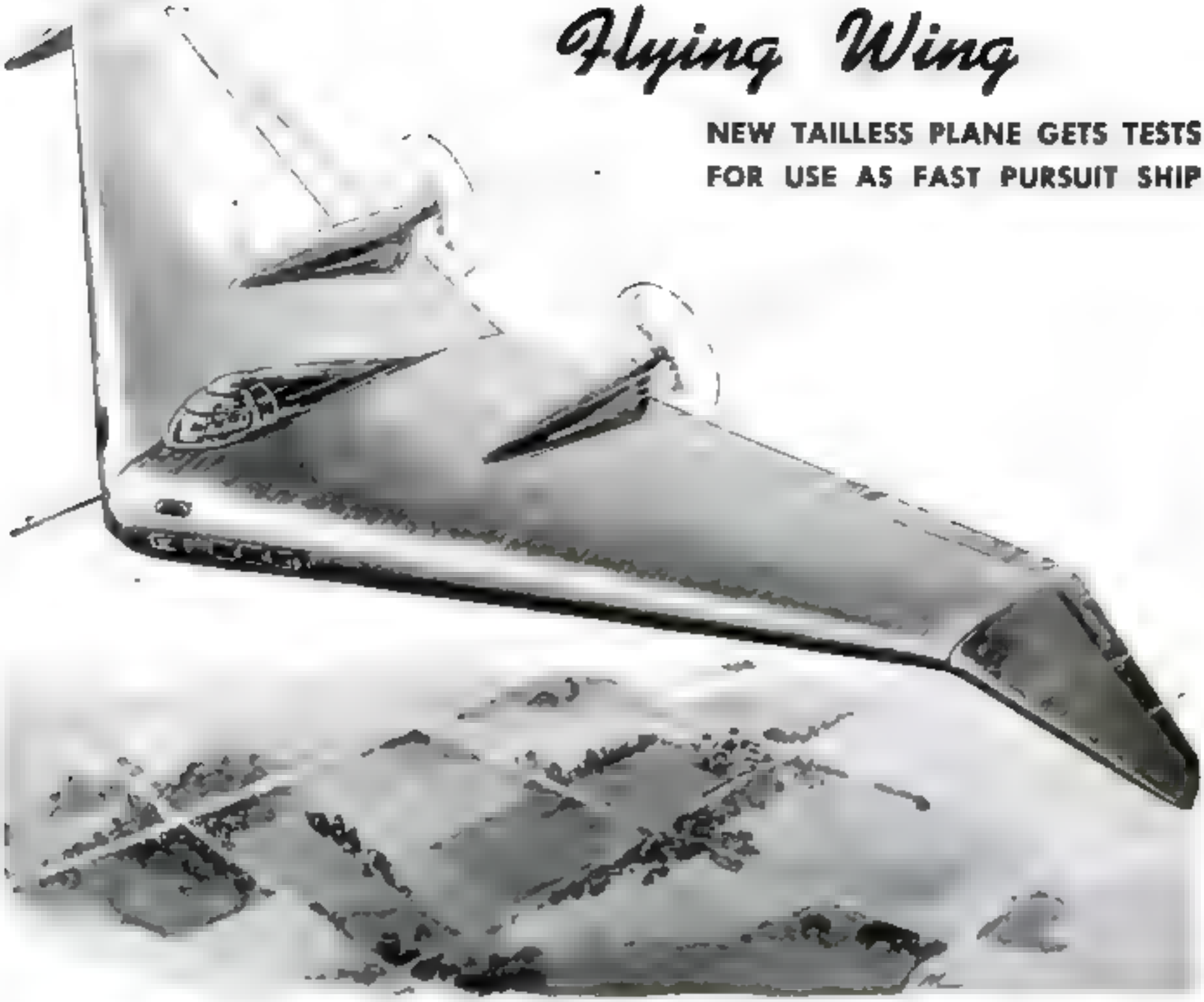
The arsenals and other Ordnance Department establishments have been using the award system since 1912 to promote a friendly feeling among its employees and also to increase the efficiency of the department. The awards are limited to $1,000 a month and are approved by the Secretary of War.



Toolmaker William G. Rohrwasser, also at Watervliet Arsenal, gave his boost to the defense program by suggesting a fixture to compress the wooden pegs used in Babbitt reamers. Saves $200 a year, plus precious time. He got $20

Flying Wing

NEW TAILLESS PLANE GETS TESTS FOR USE AS FAST PURSUIT SHIP



Except the pilot's blister and the propeller-shaft housings, every inch of surface is lifting surface

A BATLIKE PLANE with no fuselage or tail surfaces and powered by twin engines driving three-bladed pusher propellers is the latest version of the "Flying Wing" developed by the Northrop Aircraft Company.

Unlike ordinary planes, the new Flying Wing has no drag created by fuselage and engine cowling, which possess no aerodynamic lift of their own. Because of this it is expected to have a top speed well over 400 miles an hour.

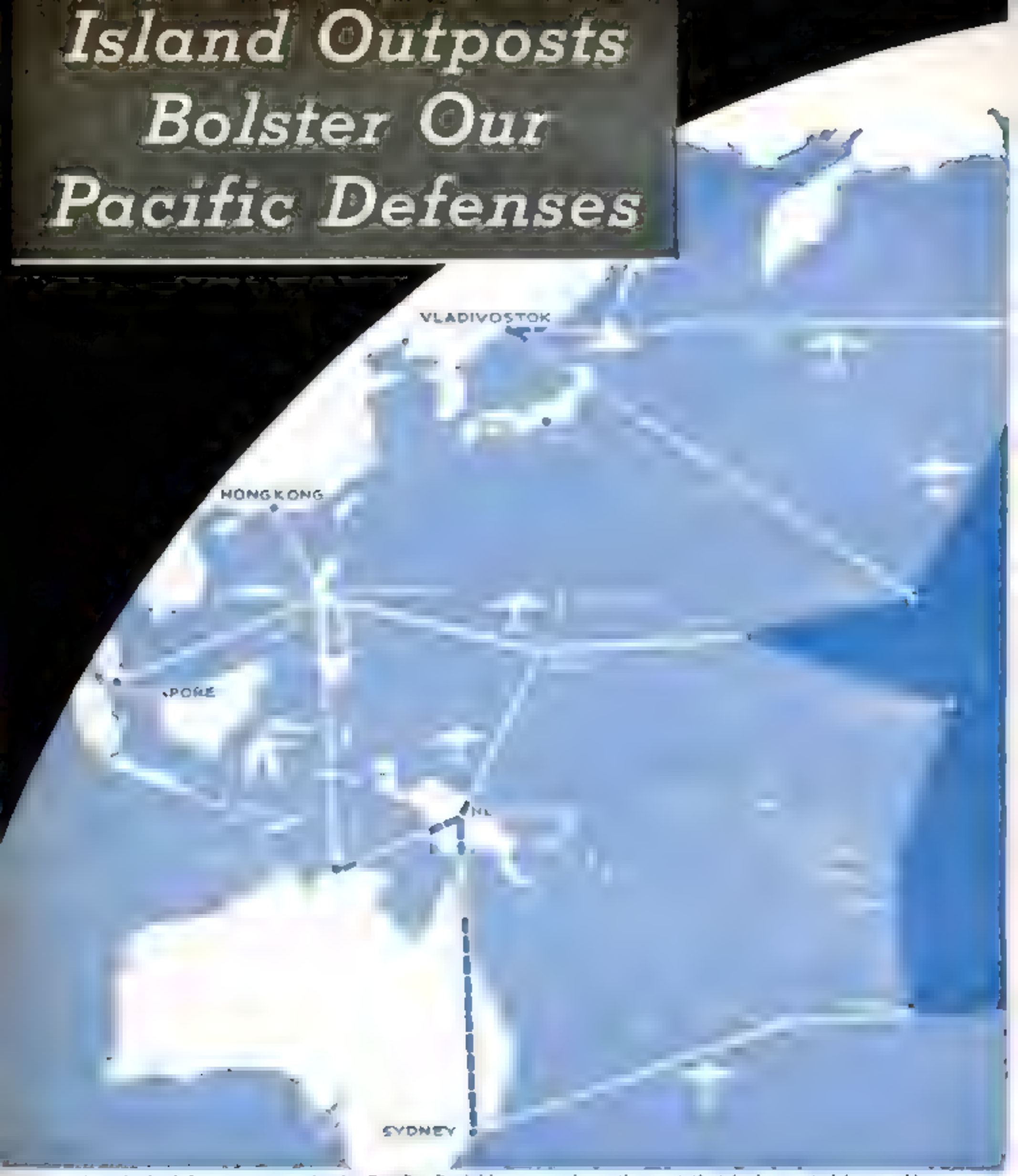
Its controls are like those of a regular plane and pilots say that there is nothing unusual about its management in the air. Armed with twin gun turrets on either side of the wing and probably other armament, the Flying Wing offers something new in fighting planes.

The Northrop Company started building this strange plane two years ago and since that time over two hundred flights have been made. It was first flown by Vance Breese, well-known test pilot, and later by others under the watchful eyes of Air Corps officers.

John Northrop's first Flying Wing, built 12 years ago, still had to drag a clumsy tail assembly with booms

While today's machine shows a family resemblance, it has shed the awkward empennage and is nothing but wing

Island Outposts Bolster Our Pacific Defenses



America's defense strategy in the Pacific. Dark-blue area shows the part that is dominated by our Navy

HOW well prepared is the United States for defense in the Pacific? Fast-moving international developments invite a quick check-up on our naval power there.

Naval power means warships. It also means planes, more so than ever before—both the short-range, land-type planes of carriers, and the long-range flying boats designated as patrol bombers. And finally, naval power means bases, without which ships and planes would be helpless to operate, once they ran out of fuel or needed repairs.

Based on the impregnable fortress of Hawaii, our Pacific Fleet today is an unknown quantity. Whether it has been depleted by transfers of ships to the Atlantic Fleet, or augmented by two-ocean naval construction, remains the Navy's secret. After our long naval holiday permitted Japan to come dangerously close to our own strength afloat, however, it seems unlikely that we

Solid line is our route to Asia via the Philippines; broken lines, our strategic links with friendly powers

would concede her any further advantage.

As for the air, piecemeal reports indicate a steady movement of planes toward the Orient. Two years ago, the air force in the Philippines existed mostly on paper. Today it is believed to exceed 1,000 planes—real ones. On the side of defense against aerial attack, vulnerable areas have been equipped with elaborate air-raid shelters. At Hawaii, preparations for a protracted siege in the absence of the fleet include a bombproof tunnel 600 feet long. Besides personnel, it will accommodate 15,000 tons of rice and other staples to feed the population. Underground tanks for aviation gasoline are the rule at all new outposts, and elsewhere they are rapidly replacing above-ground storage. Radio stations and power plants are now bombproofed.

New or greatly expanded naval air bases have come into being at Hawaii, Johnston Island, Palmyra Island, Midway Island,

U.S.S. Houston, heavy cruiser, looks over Cocos Island. This fabled treasure island, flanking approaches to the Panama Canal, is said to be the subject of negotiations with Costa Rica

Below is a map of Wake Island, one of our steppingstones to Asia. This typical coral atoll rings a lagoon whose mouth is being dredged for naval vessels

Wake Island, and the Alaskan sites of Sitka, Kodiak, and Unalaska. From these outposts, giant patrol bombers execute scouting missions for the fleet, just as one of their American-built type spotted the German battleship *Bismarck* for the British Navy to sink.

Rushed to completion months ahead of schedule, these air bases are part of a comprehensive, long-range plan worked out in 1938 by a naval board under Rear Admiral Arthur J. Hepburn. The next stage of the Hepburn program called for expanding the bases to dock and repair submarines, a comparatively simple task. Recommended submarine bases at Kodiak, Unalaska, Midway Island, and Wake Island were authorized by Congress early last year.

At the same time, provision was made for berthing destroyers, mine layers, mine sweepers, and patrol boats at Sitka and Unalaska. And long-defenseless Samoa became a projected $9,000,000 naval base—a "little Hawaii" of the south Pacific.

Fortification of Guam, storm center of political controversy, has been turned down repeatedly in Congress for fear of offending Japan. Finally, only last March, the comparatively modest sum of $4,700,000 was voted to clear dangerous coral reefs from Apra harbor, and to subdue its swells with a breakwater, so that naval patrol planes could operate safely to and from Guam.

Besides these principal bases in the Pacific, others deserve notice. Persistent rumors have arisen of negotiations by the United States with Ecuador for a site on the Galapagos Islands, and with Costa Rica for a base on Cocos Island, favored spot of treasure hunters. Not interested in buried gold and jewels, the U. S. Navy is more concerned with the islands' vantage point off the Pacific end of the Panama Canal.

Canton Island, occupied and claimed both by the United States and Britain (P. S. M., June, '38, p. 23), presents one of the most novel of international situations. By an amicable exchange of notes in 1939, each country agreed to defer pressing its claims for 50 years. Meanwhile the island is jointly governed by an American and a British official. In 1940, Congress authorized a $1,500,000 naval air base on Canton.

In the name of the United States, Hawaiian colonists have taken undisputed possession of Howland, Baker, and Jarvis Islands, and laid out runways for land planes.

Examine the accompanying map, and the grand strategy behind these seemingly random developments becomes apparent. A hostile fleet approaching the United States by the northern route is open to detection by the Alaskan naval outposts, supplemented by the new Army air bases at Fairbanks and Anchorage. Should the alarm be flashed from Guam on the central route, or Samoa on the southern one, precious time likewise will be gained in intercepting an enemy

With our own fleet on the offensive, bases behind it can furnish invaluable support for its "supply train" of cargo and repair ships by guarding them against surface or undersea raiders.

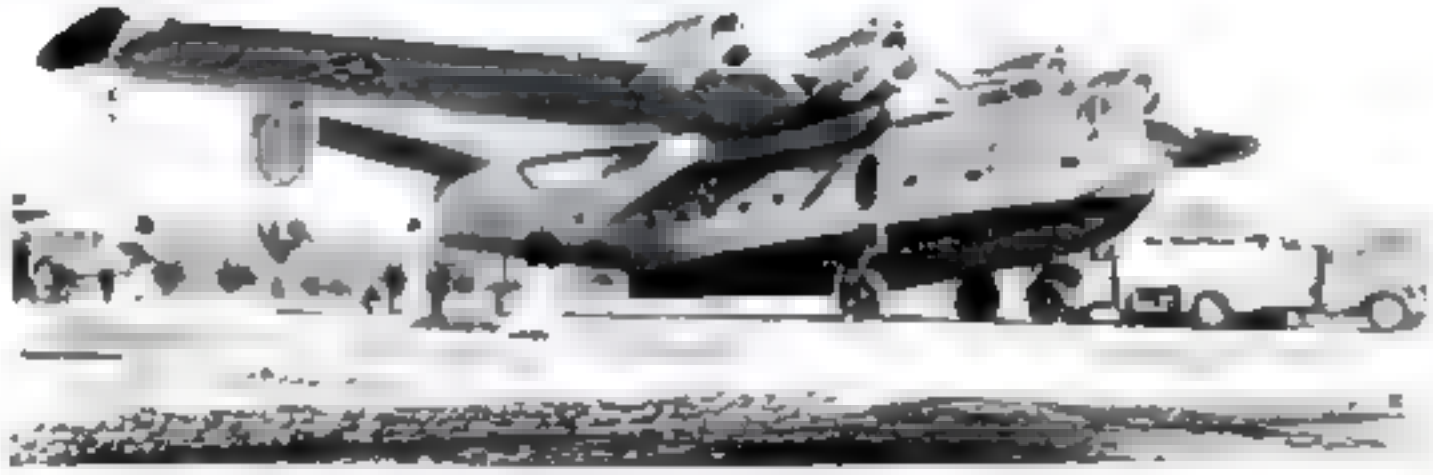
For the first time, as shown by the dark-blue area of the map, U. S. naval dominance of the Pacific has been projected past the 180th meridian, in a salient extending at

OLD AND NEW IN LOOKOUT STATIONS: From this observation tower on Guam, the nearest of the Japanese-occupied Marianas can be seen. Below, new planes widen defense horizons

least as far as Wake Island. If necessary, the fleet can proceed farther to bring equally effective pressure to bear by blockading an enemy's trade routes. Were this country to try it alone, however, there would be a long and costly war. On paper, we should win, but fortune is a fickle thing Damaged battleships would have to be brought all the way back to Hawaii for dry-docking and repairs since the Asiatic Fleet's base in the Philippines cannot handle vessels of such size.

All this now is changed by the present international scene. Britain has offered us the use of her magnificent base at Singapore; Hong Kong and Australian ports are at our disposal for the asking. "Parallel action" by British warships might be expected, as well as support from the navies and air forces of Russia and the Netherlands Indies. Well prepared as we are to defend ourselves, we are not likely to spurn the help of such valuable allies to assure complete control of the Pacific. We have at stake all our treaties and policies in the Far East; guardianship of Guam and the Philippines; our flow of war supplies to China and Russia; and strategic imports of rubber and tin from transpacific sources.

Launched from the deck of an aircraft carrier, this long-range Brewster dive bomber is a powerful weapon for control of the sea. It carries a two-man crew



Huge patrol bombers like this double-deck, four-motored Consolidated PB2Y now scout vast areas of the Pacific for hostile activities

An experimental prototype of greater planes to come: the Navy's new Martin flying boat. Its four motors have a total of 8,000 horsepower

Fiber emerging from a spinneret in which the viscous casein is forced through holes under high pressure. The "tape" is composed of thousands of individual strands

MAKING CLOTH FROM MILK

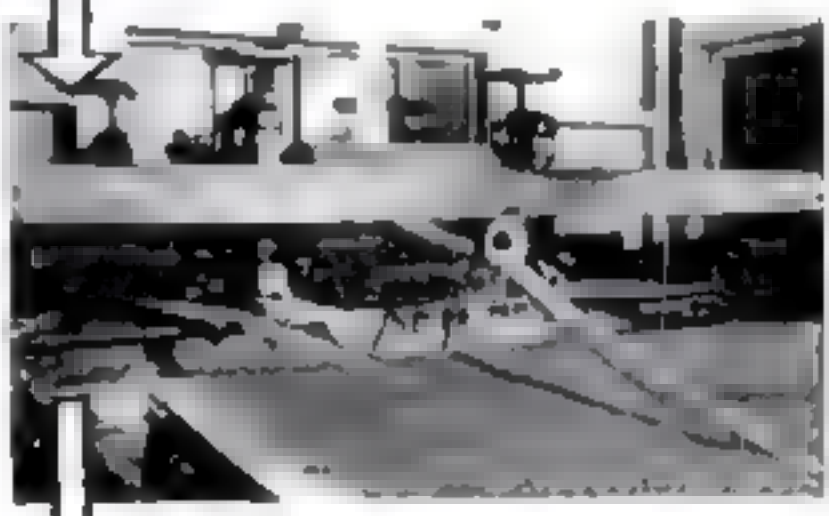
BY NEXT SPRING, women may buy Easter outfits which can be traced back to cows' milk. The fiber of this new textile is made from casein, a by-product of skim milk, and can be blended with wool, mohair, cotton, rayon, and fur in varying proportions to produce the qualities desired

Called "Aralac," it will be more expensive than rayon or cotton but will have more tensile strength, more affinity to dyes, and greater ability to withstand cleaning and washing. It also supplies drape and substance which could only be obtained in some fabrics by using fur and wool.

The present production capacity of the new fiber is about 5,000,000 pounds a year, which represents a recoverable casein content of about 160,000,000 pounds of skim milk that was formerly wasted or used for feeding livestock on farms.

Curds from skim milk, washed and dried into a substance that looks like rice are ground and treated before they go . . .

. . . to the spinning box in which four spinnerets, concealed in the foamy mass, turn it into fiber. The hand at the right shows size and translucency of the tapes

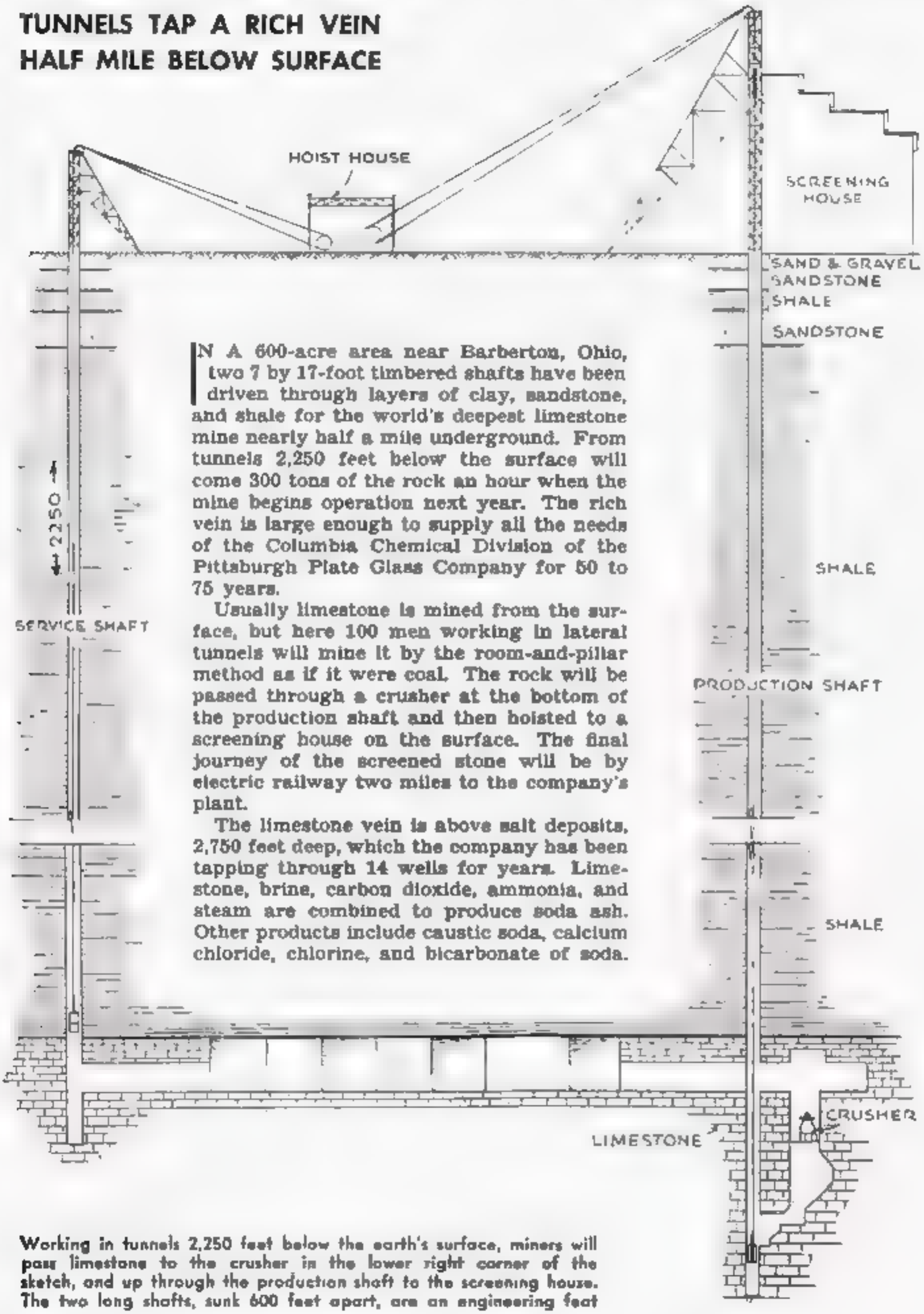


Here the casein fiber is going through one of the many chemical baths it gets during the processing. Note size of bath vat compared with that of the fiber "tow"

Long skeins of the fiber are cut into the desired lengths by the machine below. Then the fluffy material is pressed tightly into 450-pound bales for shipment

Digging Deep for Limestone

TUNNELS TAP A RICH VEIN HALF MILE BELOW SURFACE

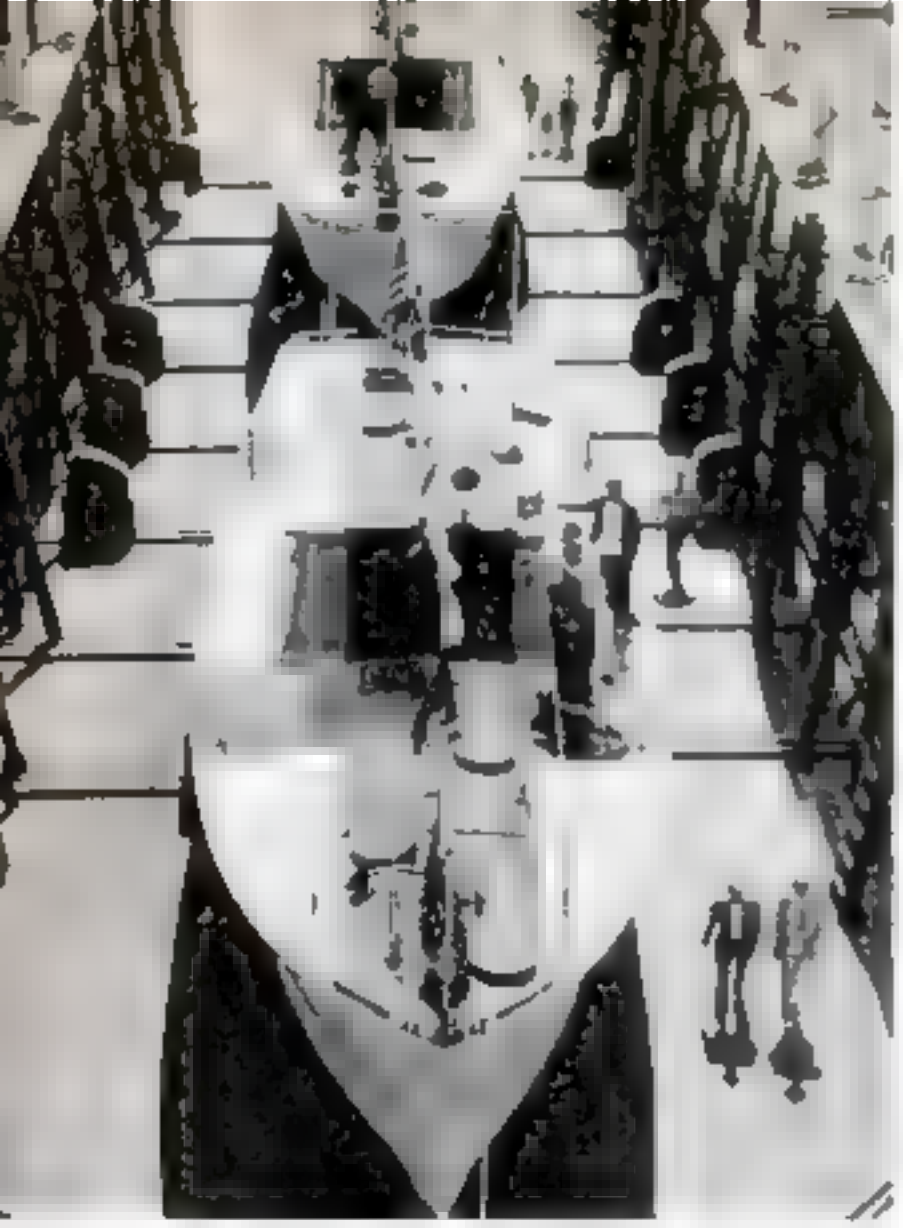


IN A 600-acre area near Barberton, Ohio, two 7 by 17-foot timbered shafts have been driven through layers of clay, sandstone, and shale for the world's deepest limestone mine nearly half a mile underground. From tunnels 2,250 feet below the surface will come 300 tons of the rock an hour when the mine begins operation next year. The rich vein is large enough to supply all the needs of the Columbia Chemical Division of the Pittsburgh Plate Glass Company for 50 to 75 years.

Usually limestone is mined from the surface, but here 100 men working in lateral tunnels will mine it by the room-and-pillar method as if it were coal. The rock will be passed through a crusher at the bottom of the production shaft and then hoisted to a screening house on the surface. The final journey of the screened stone will be by electric railway two miles to the company's plant.

The limestone vein is above salt deposits, 2,750 feet deep, which the company has been tapping through 14 wells for years. Limestone, brine, carbon dioxide, ammonia, and steam are combined to produce soda ash. Other products include caustic soda, calcium chloride, chlorine, and bicarbonate of soda.

Working in tunnels 2,250 feet below the earth's surface, miners will pass limestone to the crusher in the lower right corner of the sketch, and up through the production shaft to the screening house. The two long shafts, sunk 600 feet apart, are an engineering feat

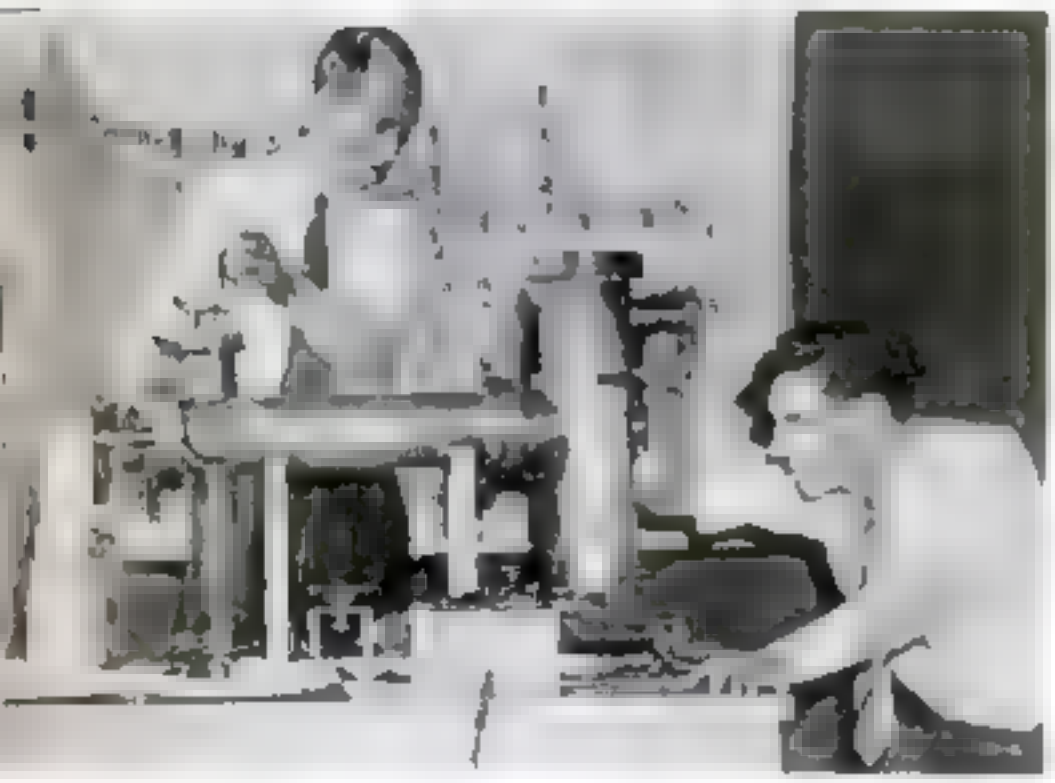


Two of the Navy's 60-foot speedboats which serve as fast-moving targets for dive bombers. Flyers try to hit crosses on their decks with nonexplosive bombs

Navy's Dive Bombers Must Be Quick to Hit New Fast-Moving Targets

NAVY dive bombers have new, fast-moving targets to shoot at—60-foot "clay pigeon" vessels powered with twin gasoline engines. The boats are heavily armored and each carries a crew of six. Instead of stationary or slowly towed targets, Navy flyers will have to hit broad crosses painted on the decks of these speedy, highly maneuverable craft which can operate in any weather. Nonexplosive bombs will be used.

Electronic Camera Photographs Minute Crystalline Structures



Dr. Ralph P. Johnson, left research physicist, and his assistant, William Grams, focus his new electronic camera for a microscope metal study

CRYSTALLINE structure of substances millionths of an inch thick can be photographed by this new electronic vacuum camera in the General Electric Research Laboratory. Built by Dr. Ralph P. Johnson, it is being used to study deposits on the surfaces of metals—tarnish, polish, grease, oil, and the first stages of corrosion. The camera consists of a brass tube, 3½ feet long, and a focusing magnet. A 40,000-volt electronic beam enters one end of the tube, is focused by the magnet on material suspended in the middle, and produces a picture on a lantern slide at the other end. The electronic beam, reflected by or transmitted through the material examined, produces a diffraction pattern or picture of the structure on the lantern slide. The spacing and intensity of the circles or spots of the pattern identify the crystalline structure.

Below, left to right, the electronic patterns of oxide formed by melting foil from a cigarette package, the surface of a polished tungsten block, and the thin layer of oxide formed by melting aluminum foil

Fire Truck Safeguards Apartments

WHAT to do until the firemen come is amply provided in a one-man fire truck suitable for use in apartment houses, stores, factories, and office buildings. It contains complete equipment for combating blazes starting in wood, oil, or electric wiring, and is small enough to be pushed rapidly by hand along hallways, through doors, or onto elevators.

The truck, designed and built by George J. Woehrlin, a building superintendent for a New York real estate and management agency, is a steel-braced wooden platform, 28 inches wide by five feet long, supporting two solid equipment racks and mounted on rubber-tired swivel wheels. The overall height is four feet.

Nested on it skillfully, so that each piece is easy to get at, are two extinguishers for ordinary fires, two special ones containing tetrachloride, 100 feet of regulation hose, and two rectangular sand buckets. There are also axes, saws, chisels, sledges, wrenches, and other tools; a smoke-penetrating spotlight, a coil of heavy rope, and several waterproof salvage blankets.

This compact fire truck is designed to put out small fires or keep them from spreading while the firemen are on the way

Included in the equipment above are a spotlight, rope, assorted tools, extinguishers containing tetrachloride, and sand buckets. There are two other extinguishers for use on wood or oil fires

Regulation fire hose and waterproof salvage blankets are arranged for quick work as shown at left. Gloves and a gas mask are among the equipment in the boxes

ASTRONOMERS STUDY

Explosions on the Sun

TO SOLVE THE MYSTERY OF THE AURORA BOREALIS

By JACK STEELE

THE centuries astronomers have spent in studying the aurora borealis are at last producing results. Many of the mysteries remain unsolved, but science is making strides to combat the destructive electromagnetic storms which sweep the earth when brilliant displays are observed in temperate latitudes.

These auroral shows are now regarded as warning lights which flash when the balance of electrical forces playing in the universe is disturbed. These disturbances are felt on the earth as magnetic storms which blot out short-wave radio reception, tangle or ground telephone, telegraph, and cable circuits, deflect the compasses of ships and airplanes, and cause other delicate instruments to act erratically.

The aurora of September 18, 1941, one of the brightest ever observed generally throughout the United States, gave scientists an excellent opportunity to test their defenses. Both aurora and storm were forecast accurately. Government observers, using new instruments, obtained the first complete scientific record. Engineers utilized new techniques and equipment to counteract the effects. The records indicate that the storm was of near maximum intensity.

Astronomers had discovered that auroras usually occurred after periods of great sunspot activity, which, they now believe, cause both the auroras and magnetic storms. Using this theory they predicted the September 18 show.

On September 16 a great cluster of sunspots measuring 150,000 miles across (nearly a fifth the diameter of the sun) was photographed by the United States Naval Observatory. H. W. Wells, of the Department of Terrestrial Magnetism of the Carnegie Institution, forecast the aurora and storm. The five magnetic observatories of the Coast and Geodetic Survey were notified, and warnings were broadcast.

The magnetic disturbance began two days later. A faint aurora was observed just before dawn by Robert Coles, assistant curator of the Hayden Planetarium in New York. That night people across the United States observed the dazzling aurora. The storm continued for four days.

Sunspots are believed to be storms rag-

Aurora Borealis: Painting by Leonard Davis, courtesy of the Hayden Planetarium

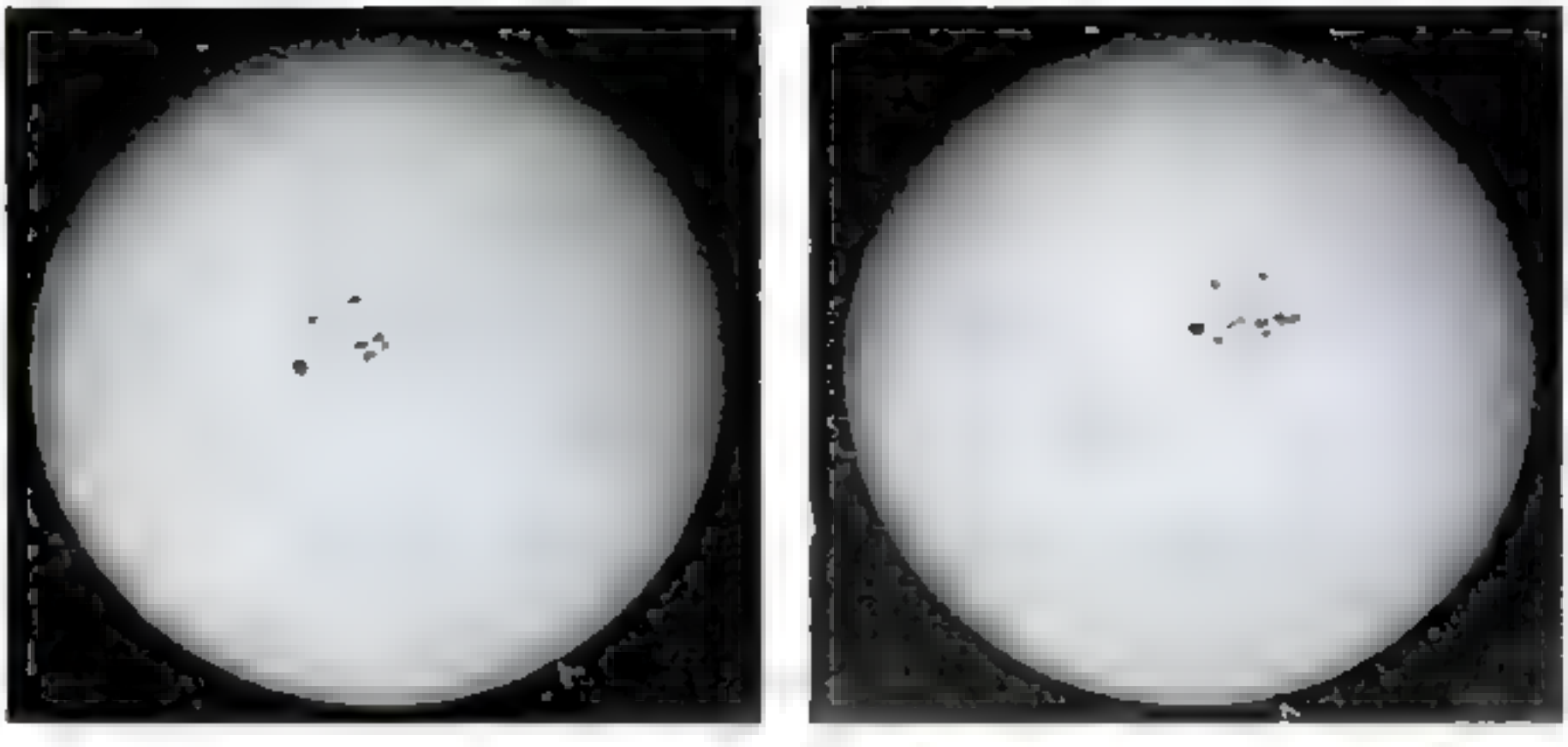
ing in the hot gases of the sun's surface. Streams of electrical particles, spewed into space at terrific speed, strike the atmosphere 60 to 600 miles above the earth, bombarding atoms of atmospheric gases, stripping them of their outer electrons, and causing them to luminesce. The colors resulting depend on the mixture of gases. Greens and livid whites usually predominate. Rose and purple were also observed on September 18.

The particles streak on until trapped by lines of magnetic force and turned toward the magnetic poles, just as are the needles of compasses. The particles cause the ground potentials of the earth to rise sharply and magnetic intensities to fluctuate.

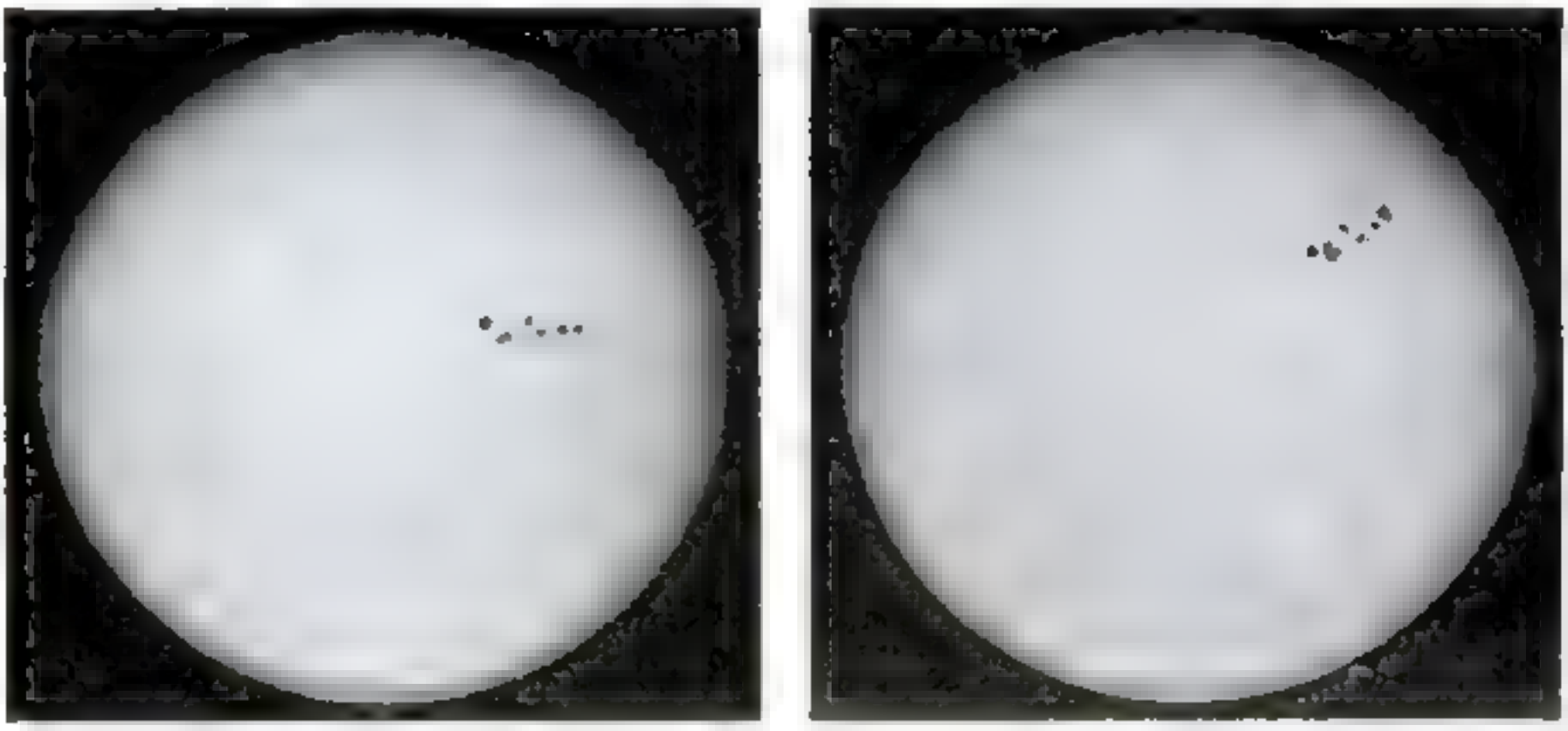
Three instruments are used to measure the horizontal and vertical intensity of the forces and to plot the angle of declination from the astronomical or true meridian. They are so sensitive that a trolley car a quarter of a mile away or a penknife in the street near-by will ruin the observation. During a severe magnetic storm their deviation is so great that it cannot be recorded on sensitized charts. A new device, the La Cour Insensitive Magnetograph, was invented to overcome the difficulty. Recently installed at the Cheltenham Observatory, near Washington, D. C., it made the first complete record of a severe storm on September 18.

An index was plotted, with zero as normal and 9 the maximum value. For five three-hour periods on September 18 the index value was 9. The horizontal intensity reached 2,544 gammas, close to the instrument's maximum of 3,000

Despite the severity indicated by these figures, there seems to have been much less disruption of communications than during another heavy storm on March 24, 1940. Short-wave radio communication with Europe was cut off for considerable periods, but a long-wave circuit, which was not affected, was operated to London. Short-wave communication was maintained by detouring it by way of Buenos Aires. Radio transmission in a north-south direction is not disturbed as much as that passing east and west, and since channels between New York and Europe follow the "great circle" near the north magnetic pole, routing the beam



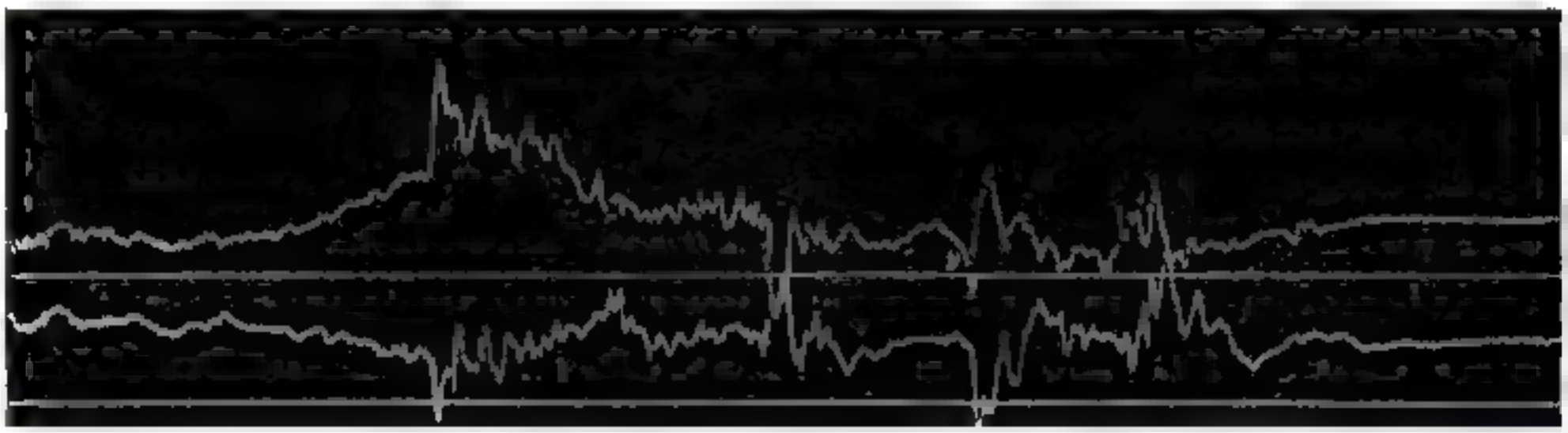
Spots moving across the face of the sun before and during the magnetic storm last September. Above, left to right, September 16 and 17 before the disturbance; below, during the storm September 18 and 19



to Buenos Aires easily avoided this area.

The Bell system reported that both telephone and telegraph circuits were disturbed much less than during the 1940 storm. Telephone interruptions occur chiefly when high ground potentials cause carbon protectors to function. Only 73 such protector operations were reported on September 18 as compared with thousands reported during the previous storm.

This chart, made September 18, covers the day of greatest intensity and is the first complete record of a severe magnetic storm. On earlier instruments, deviations are so great they cannot be recorded



A built-in altimeter and an angle-measuring device allow this new aerial camera to be focused to pinpoint sharpness. It is capable of sharp focus at a distance of 30 miles and a height of 20,000 feet

•

From a 1,200-foot altitude and an angle of 35 degrees, the camera's 14-inch Extar lens was focused at 1,710 feet to get the photo below

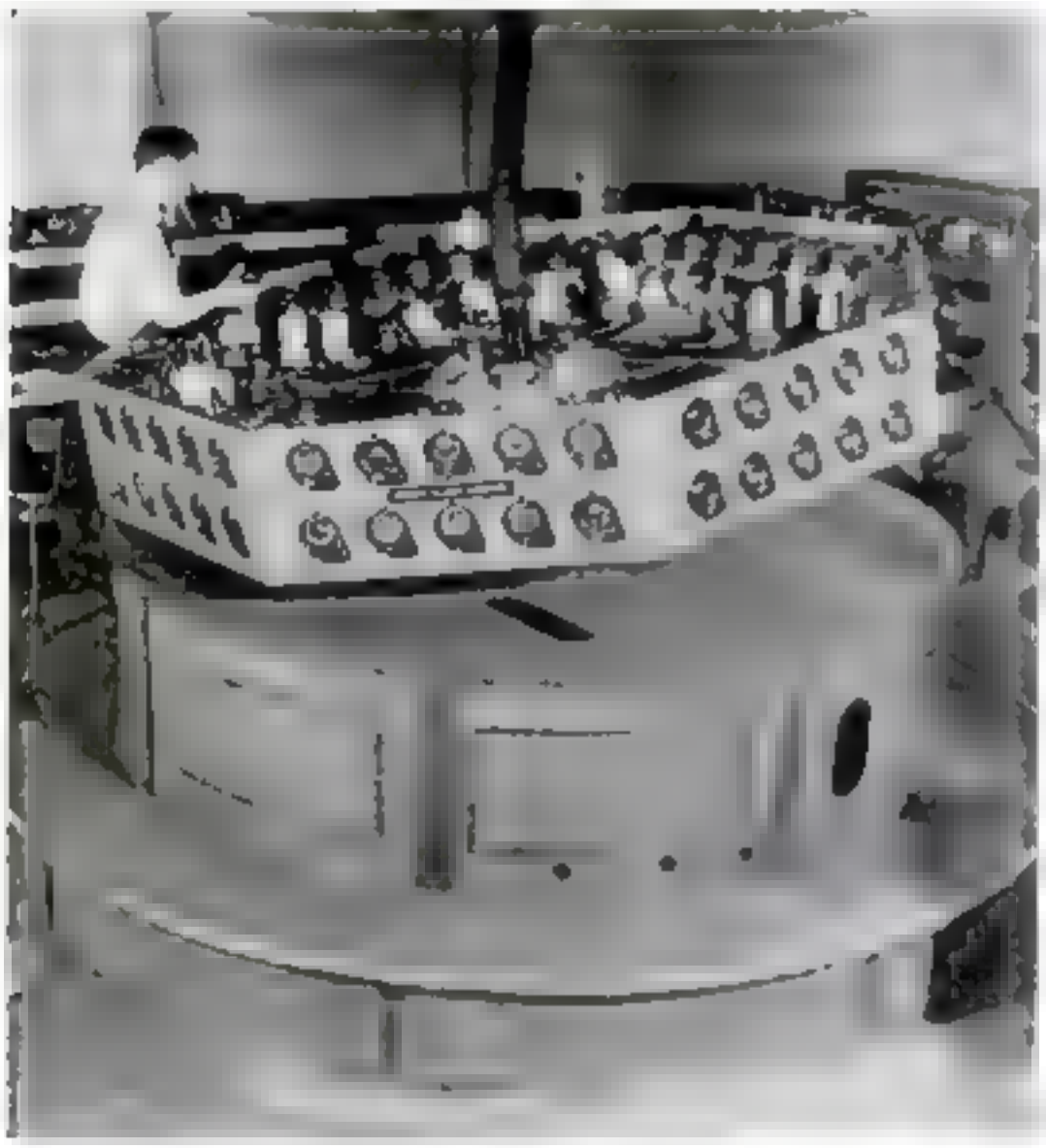
Machine-Gun Aerial Camera Makes a Picture a Second

A NEW aerial camera with the speed and accuracy of a machine gun can take a picture a second from a plane flying 400 miles an hour. It was developed by Robert E. Phair, Los Angeles photographer. The camera uses either cut or roll film with more than 200 exposures, and has a between-lens shutter operating at 1/2,000 second. A sensitive built-in altimeter and an angle-measuring attachment are used in combination for computing the range in adjusting the camera to a sharp focus.

Fitted, as at left, with high-speed 5 by 7-inch roll film, the camera operates almost as fast as the trigger can be pulled. When cut film is used, the platen wheel in the picture at right fastens the plate holder tightly in place. Stop-motion views can be taken from a plane flying 400 miles an hour

Instruments Used in Airplanes Get Rough "Flight Test" on Ground

GYROSCOPIC aviation instruments get a rougher "flight test" at the Brooklyn, N. Y., plant of the Sperry Gyroscope Company than they meet in actual service. An octagonal-shaped section of a machine, called the "Flight Scorsby" amplifies the pitch, roll, and yaw of flying for 80 instruments. Sperry used a 24-instrument Scorsby before the defense emergency.



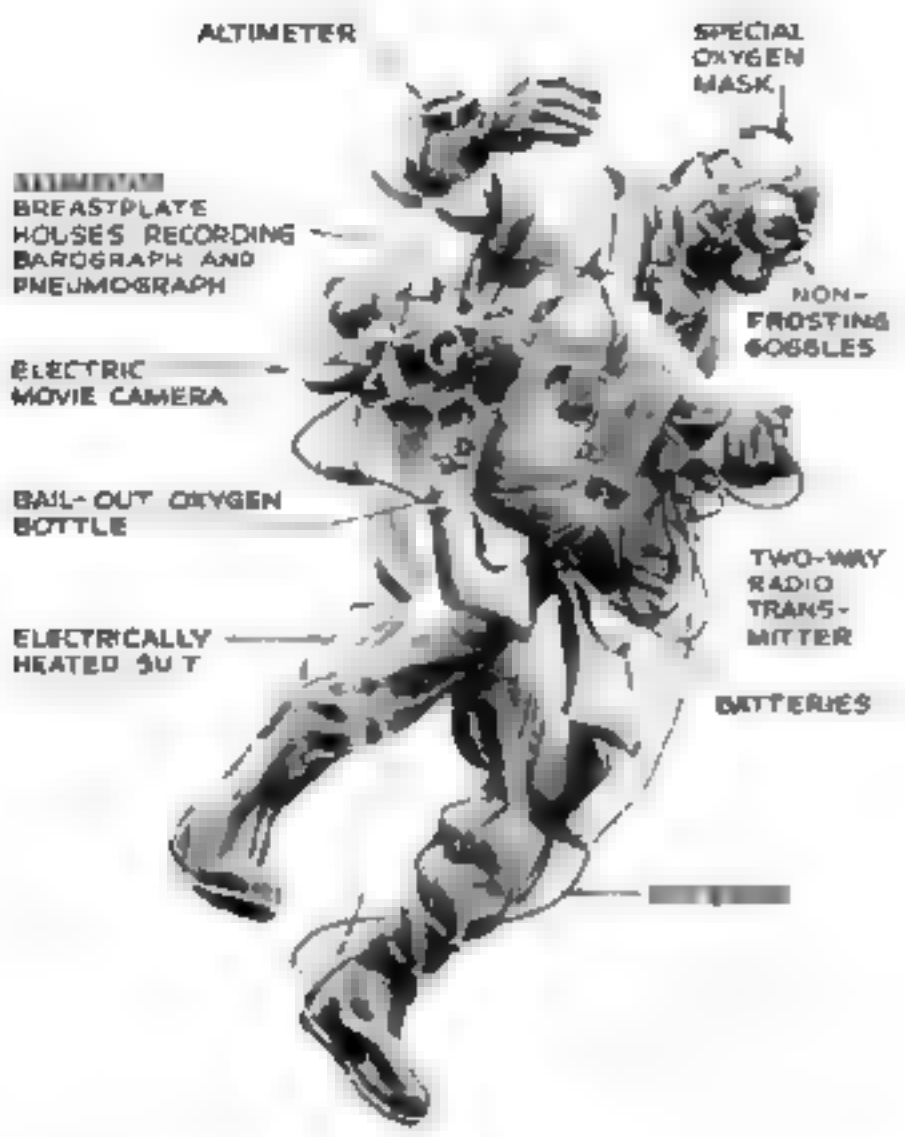
Each panel of this rolling and pitching device at the Sperry gyroscope plant takes ten instruments on a complete "flight"

Constant-Speed Propeller Made for Small Planes

A LIGHT, constant-speed propeller, with automatic pitch of the blades fixed by the throttle control, now is available for small planes. Developed by the Everel Propeller Corporation and approved for Lycoming's geared 75-horsepower engine, it has only 30 hub parts. The principle is based on balancing the aerodynamic forces and centrifugal force acting on the blades. Constant engine revolution is thus achieved, making full rated engine power available for take-off, climb, and level flight, and in acrobatics.

Operator, Attendant, and One Patient Ride on Scooter Ambulance

ONE-PATIENT emergency ambulance service is provided by a motor scooter which has a canvas-covered litter, mounted on springs over a wood and steel frame, as a side car. Slide-fastened windows may be opened for ventilation or observation of the patient by an attendant riding behind the driver. Army officials at Washington arranged for a demonstration by Alfred Malling, of Los Angeles, the inventor.



Jumping Human Laboratory Tests 33,000-Foot Fall

HOW FAR can a man fall safely through the air? Scientists, engineers, and equipment manufacturers have joined in wrapping the floating laboratory at left around an airman to test the theory that proper protection against the elements, and an adequate supply of oxygen, will bring him down from any altitude without ill effects. The jumper, leaping from a plane in the substratosphere at 35,000 feet, drops 33,000 feet before opening his parachutes. Two are required, for he carries 113 pounds of equipment and instruments to record physiological and other changes on the way down. An electrically heated suit protects him from the cold, a bail-out bottle provides oxygen, and a radio keeps him in contact with the ground. Other instruments that are attached to his harness include a pneumograph, barograph, and altimeter.

Ancient Ship Timbers Recovered for Modern Fighting Craft

ANCIENT live-oak timbers, now almost impossible to get, are being dredged up at the Brooklyn Navy Yard, to help build modern fighting ships. Live oak was used in wooden war vessels because of its extreme hardness. The timbers recovered from 80 feet of water and mud probably were Civil War supplies. The wood doesn't rot under water and some will be used for keel wedges, necessary in precision adjustment at the ways.

These huge live-oak ship timbers, buried under water for 80 years, dwarf the two men in the circle

Astride a nacelle the flight engineer of a Flying Fortress directs an engine mechanic in going over one of the four big power plants. Either in the air or on the ground he's the boss

. . . and here is the little army he commands—ground-crew chief, engine mechanics for four motors, and apprentice mechanics. His assistant is the only other mechanic who goes up with the plane; the rest are employed in servicing her between flights

He wears the chevrons of a technical sergeant, but he's the kingpin of the crew of a Flying Fortress. He knows every rivet and gauge in the giant plane and watches over her like a hen with a single chick. Somebody else pilots her, but the flight engineer is the guy that makes her fly!

Boss of the 15th Bomber

By BARRETT McGURN

THREE years ago he was a young, raw Army recruit. He knew a little about mechanics and practically nothing about soldiering. Today he is the "boss" of a big bomber, the aerial engineer of a B-17 Flying Fortress, and that ship is his career—an Army career that has given him the schooling and experience to fit him for the same sort of job on a transoceanic clipper or a big commercial land plane when the emergency is over.

He doesn't pilot a plane and he wears only the stripes of a technical sergeant, but he is an important man in the Air Corps. He knows every rivet and gauge in the bomber he grooms and broods over. Whether it is in the air or on the ground it is *his* ship. The Army concedes that, and it is just as well, for the aerial engineer would not relinquish his proprietary rights in a plane for all the armed forces of the nation.

The mechanization of the Army has not dehumanized it. Every Flying Fortress with its four engines, its wing spread of 103 feet, and its rudder that stands 20 feet high, demands the complete understanding of one man and that man is its aerial engineer. The Army realizes this dependence and is providing for the care of the monsters which are being turned out in increasing numbers. Enlisted men who are to be their nurses already are assigned to the factories where they are taking form, watching their development from embryo.

Westover Field in western Massachusetts, the $9,000,000 base for the heavy bombardment groups of the Northeastern States on which work was started 18 months ago, is an example of the demand there is going to be for aerial engineers. Westover has only a few Flying Fortresses now; within a year it will have between 100 and 200,

BOMBARDIER

NAVIGATOR

PILOT

each of them dependent upon the affectionate and vigilant care of one man.

The Army is searching out these men and training them. Some of them are still raw recruits at $21 a month, getting their first six weeks' training in the rudiments of soldiering. Some time during this six weeks the recruit gets an aptitude test which will show whether he is mechanically inclined or otherwise

That is the first step. The man whose test shows a decided mechanical bent generally gets an opportunity to request assignment to the ground crew of an air squadron. If he already has his eye on the rating of aerial engineer, he asks for assignment to a transport, reconnaissance, or heavy-bombardment outfit instead of to an attack or pursuit squadron.

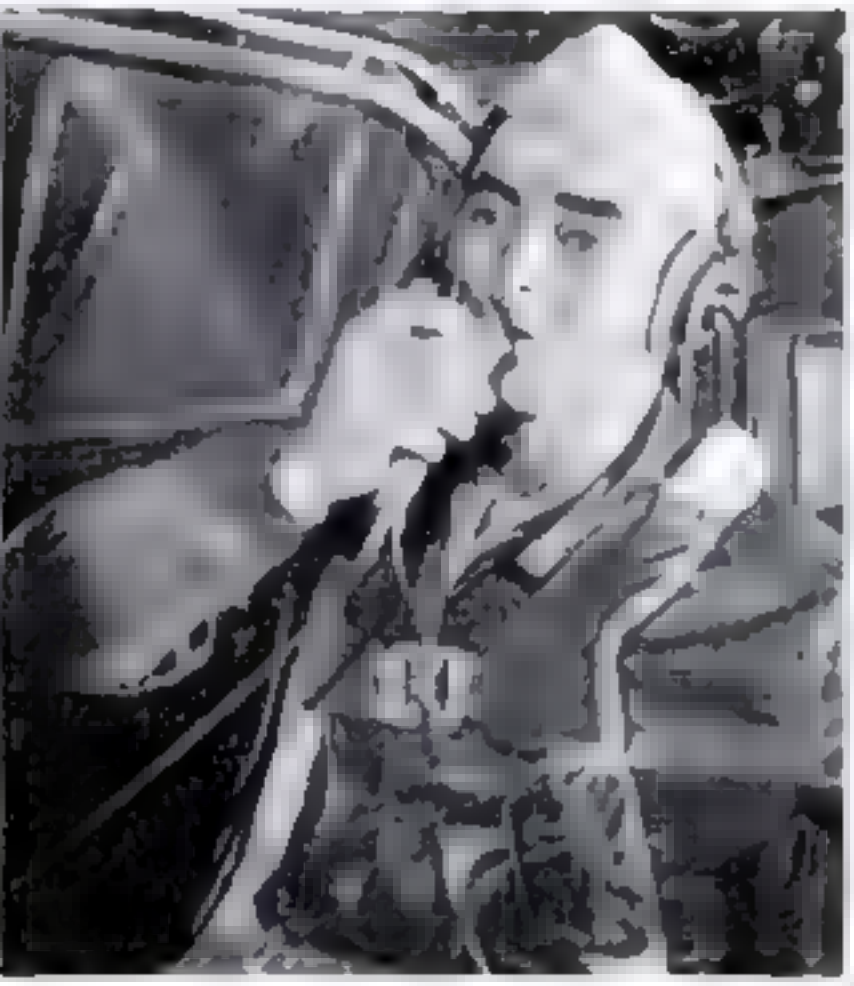
If his request is granted, he goes to the squadron as a recruit and has the chores of a recruit to do during his sizing-up period. He gets kitchen-police and guard-duty assignments, fatigue details, and polices the field in general. He may be at these jobs for days or weeks, and then comes an opportunity to go to school and take a course in aerial mechanical engineering which would cost him at least $900 if he undertook it independently.

First he takes an intelligence test and then an examination in mathematics. The examination is thorough and will reveal any weakness in fractions, decimals, ratio and proportion, square root, or elementary algebra. When he has passed it he has the choice of several courses in Army Air Corps technical schools—airplane mechanics, aircraft armoring, machining, metalworking or welding, parachute rigging, photography, radio operation and mechanics, Air Corps clerical work, and weather observation.

Scores of schools in various parts of the country are giving these courses. Some of them are private aviation schools which the Army took over as they were, retaining the civilian teaching staff and putting an Army officer in charge. Some are strictly military institutions. Their Army students number more than 100,000 annually. At some bases a third of the personnel was absent in school at a time. The students pay no tuition. They get their Army pay and board and lodging

The airplane mechanic's course is the one that leads to the job of aerial engineer. It covers airplane construction principles, maintenance and repair of a plane, its engine and equipment, and the use of tools and equipment in a hangar. The student is instructed in the operating principles and repair of airplane instruments; the construction principles and repair of the fuselage, wings, and landing gear; the installation and care of de-icer equipment, hydraulic systems, and pneumatic equipment; the

It takes a crew of eight men—four officers and four enlisted men—to fly one of the big B-17 Flying Fortresses. Their stations in the plane are shown in the diagram at the left. Far forward in the transparent nose ❶ crouches the bombardier. Behind him to his right is the post of the navigator ❷, who plots the bomber's course to its objective. In the cockpit above, looking out over the front of the fuselage, sit the pilot ❸ and copilot ❹. These four men comprise the officer personnel. The flight engineer ❺ and his assistant ❻ sit side by side farther back in the belly of the bomber. A compartment behind them is the domain of the first radio operator ❼ and his assistant ❽



FLIGHT ENGINEER

FIRST RADIO OPERATOR

FIRST RADIO OPERATOR AND ASSISTANT

construction principles and repair of propellers; the principle of the internal-combustion engine; the repair of storage batteries, generators, starters, spark plugs, and wiring assemblies; and the technique of periodic plane inspections.

Graduates may take advanced courses in the construction principles and repair of carburetors and airplane instruments, electrical units and propellers, weather forecasting and the care and maintenance of the nation's great military secret, the American bombsight. The bombsight, however, is not within the province of the aerial engineer. Only two men of the 250 in a squadron handle that and they are chosen with the strictest care.

The school graduate returns to his squadron as an apprentice mechanic, generally with the rating of corporal, and gets his first chance to do some work on one of the big bombers. Again, however, he finds himself a beginner, with only the humbler tasks assigned to him—chiefly, at first, the wiping up of oil. The aluminum pistons of a Flying Fortress do not fit the cylinders closely until the heat of the running engine has expanded them and until then the engine sprays oil, distributing about a quart over everything within range

Kerosene cannot be used in cleaning off this oil because of its inflammability. The apprentice mechanic has to use carbon tetrachloride, a vexatious fluid which evaporates at the first swipe. The oil sprayed by the bomber's engines leaves a film even in places seemingly inaccessible, and the apprentice mechanic hunting it down becomes familiar with every part of the engine mechanism battery, fuel booster pump, tachometer drive, carburetor control,

and piston. It is his job, too, to change tires, wipe windows, wash the fuselage, and use a vacuum cleaner. Every inch of the ship becomes familiar to him and he knows where everything belongs.

On the first Mondays of June and December there are tests in theory and practice covering the ground the apprentice mechanic went over in his school course and if he passes these tests he can qualify for the rank of air mechanic, a rating which may increase his pay considerably. An air mechanic, second class, draws $72 a month, which is as much as a staff sergeant gets. An air mechanic, first class, receives $84 a month, the pay of a technical sergeant. The air mechanic, however, may still rank only as a private. An able apprentice mechanic may be able to emerge from that classification within three months and become an engine mechanic, one of whom services each of the four engines of a bomber.

Each engine mechanic has full charge of his engine and full responsibility for its performance. He examines every part of it daily. After every flying period of 54 hours he changes spark plugs and cleans oil and fuel strainers and inverters. After 350 hours, plus 20 percent if performance still is good, the supercharger is removed. After 450 hours the engine is removed and sent away to be rebuilt.

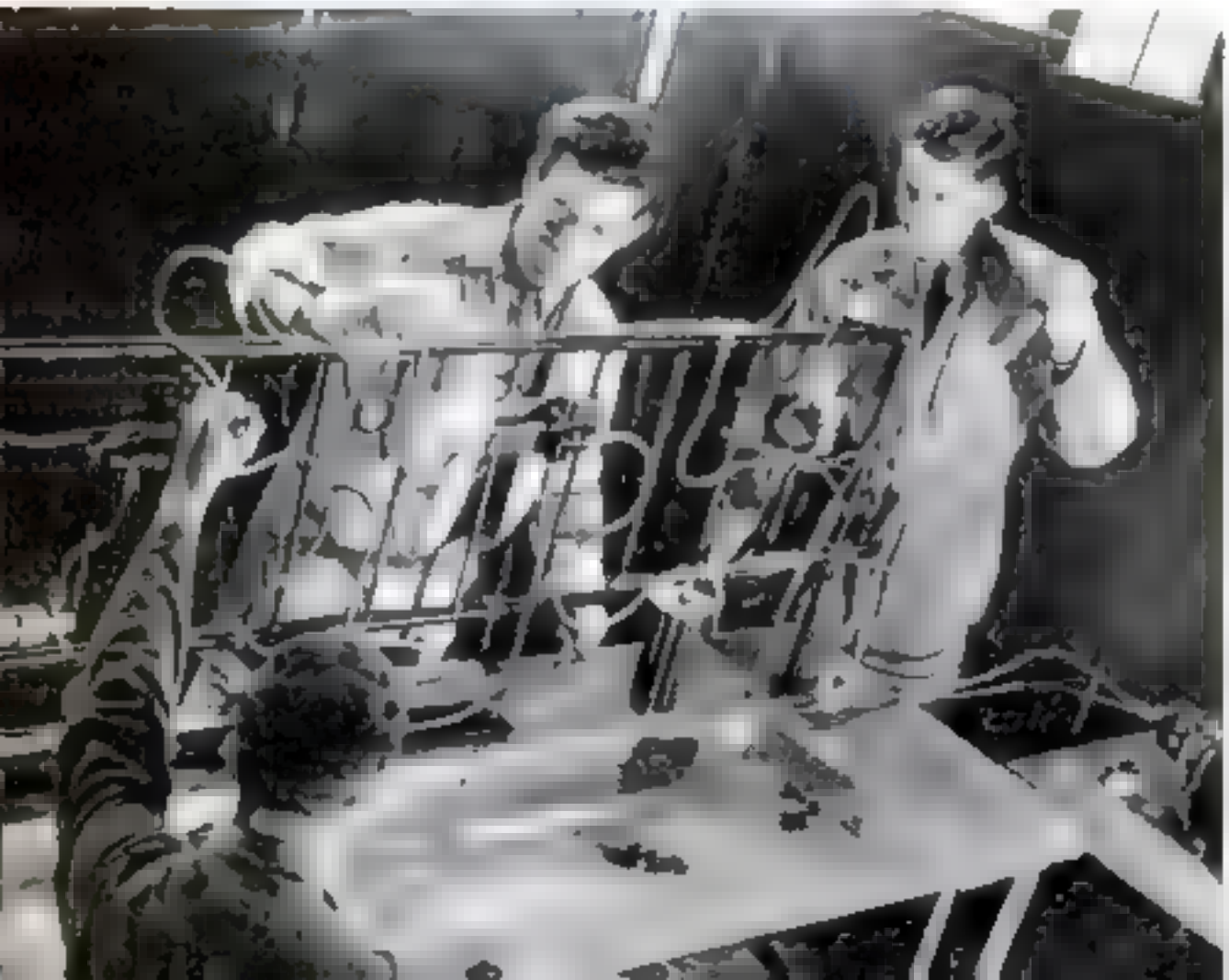
The rapid development of the military airplane has resulted in so many changes in construction that the Army Air Corps is assigning its expert mechanics to the factories which are turning out equipment for it, the Glenn L. Martin Company in Baltimore; the Consolidated Aircraft Corporation in San Diego; the Lockheed Aircraft Corporation in Burbank, Calif.; the Curtiss-Wright Corporation and the Bell Aircraft Corporation in Buffalo; the Douglas Aircraft Company, Inc., in Santa Monica, Calif., and the Pratt & Whitney Engine Division and the Hamilton Standard Propeller Division of the United Aircraft Corporation in East Hartford, Conn.

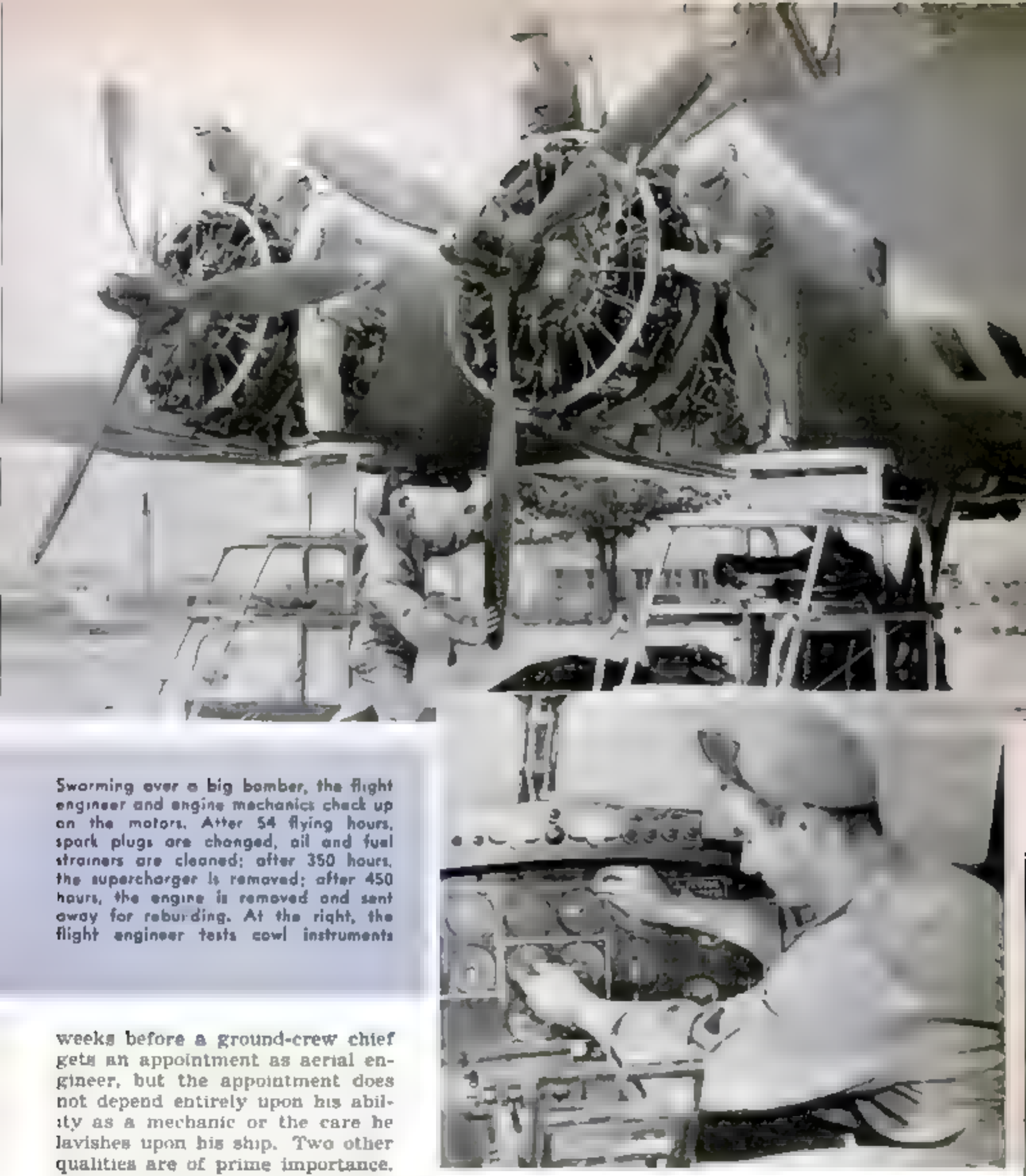
In peacetime it took two or three years for an engine mechanic to take the next step in advancement, that to the post of ground-crew chief. It may be done now in a few months. The ground-crew chief, who stands next to the pinnacle of aerial engineer, generally commands the rating of technical sergeant and is at the head of a crew of 20 men—the four engine mechanics and 16 apprentices

He makes a detailed inspection of the ship every day and scrutinizes each of the engines At 50 hours he checks the brakes, removes the wheels and inspects the bearings, washing them and repacking them. At 100 hours he takes off the tires and examines them with care.

It may be only two or three

At right, Major General Rush B. Lincoln, commandant of the Air Corps Technical Schools, watches a student at work at the Academy of Aeronautics, LaGuardia Field, New York City. Below, embryo flight engineers study a mock-up of a hydraulic assembly of the DC-3 cargo plane at Casey Jones School, Newark, N.J.





Swarming over a big bomber, the flight engineer and engine mechanics check up on the motors. After 54 flying hours, spark plugs are changed, oil and fuel strainers are cleaned; after 350 hours, the supercharger is removed; after 450 hours, the engine is removed and sent away for reburding. At the right, the flight engineer tests cowl instruments

weeks before a ground-crew chief gets an appointment as aerial engineer, but the appointment does not depend entirely upon his ability as a mechanic or the care he lavishes upon his ship. Two other qualities are of prime importance. He must be immune to airsickness and must have deadly accuracy with a machine gun. Like the rest of the enlisted personnel of a Flying Fortress, he must rate as an expert gunner to have a seat in his ship in flight.

The aerial engineer does everything for his ship except fly it. He probably *could* fly it in a pinch, since he is so thoroughly familiar with it. Before the ship takes off he inspects every part of it and starts the engines. On the new B-24's he will have his own instrument panel to synchronize the power of the four engines. Technical Sergeant Arthur E. Chatfield of the 34th Bombardment Squadron at Westover thinks that it's the power of the engines that commands the loving respect of the aerial engineer.

"When the pilot gives it the gun," he says, "and it snaps you back in your seat, you know you've got something there. Boy, you can tell that you've got some horses in front of you!"

How Canada Is

Wearing gasproof clothing and mask, a Canadian soldier prepares to set out a smoke cartridge

Beating Her Plowshares into Swords, Our Neighbor Pours Men and Materials into War

By ARTHUR GRAHAME

WITH less than one tenth the manpower of the United States, Canada has already thrown a decisive and startling volume of military and industrial power into the battle against Hitler. Its army of 400,000, of whom 100,000 are in England, is the largest in its history. Its planes and pilots, which when they were few fought savagely in the Battle of Britain, today number more than 100,000 Air Force personnel and thousands of planes. The Navy, expanded more than ten times, maintains vigilant watch over the North Atlantic. And finally, Canadian industry, relatively small in 1939, today furnishes most of the equipment for the Dominion's own armed forces, and within six months will reach its production peak, a full year ahead of the United States.

The transformation of the Dominion's economy from agricultural to industrial has been a modern machine-age miracle. A nation of farmers, trappers, miners, and traders has turned into a nation of soldiers and factory workers. During this fiscal year, Canada is making a literal gift of 1½ billion dollars in war equipment to the Empire and fully half of the Empire's air strength will eventually come from the Dominion—two

Fighting Hitler

reasons why every Canadian is giving up almost one half of his income in taxes.

As aviation-minded as any people on earth, the Canadians have made their most conspicuous war effort in the air. At the beginning of the war, the Dominion's aircraft industry was very small. This year its production has approached 200 planes a month—bombers, fighters, and trainers and it still is increasing.

But producing planes is not enough. Men must be trained to man them. And when the Nazis invaded Poland the Royal Canadian Air Force consisted of some 4,500 flyers and groundmen. Today its strength, including the civilian employees, is close to 100,000 and still is growing rapidly.

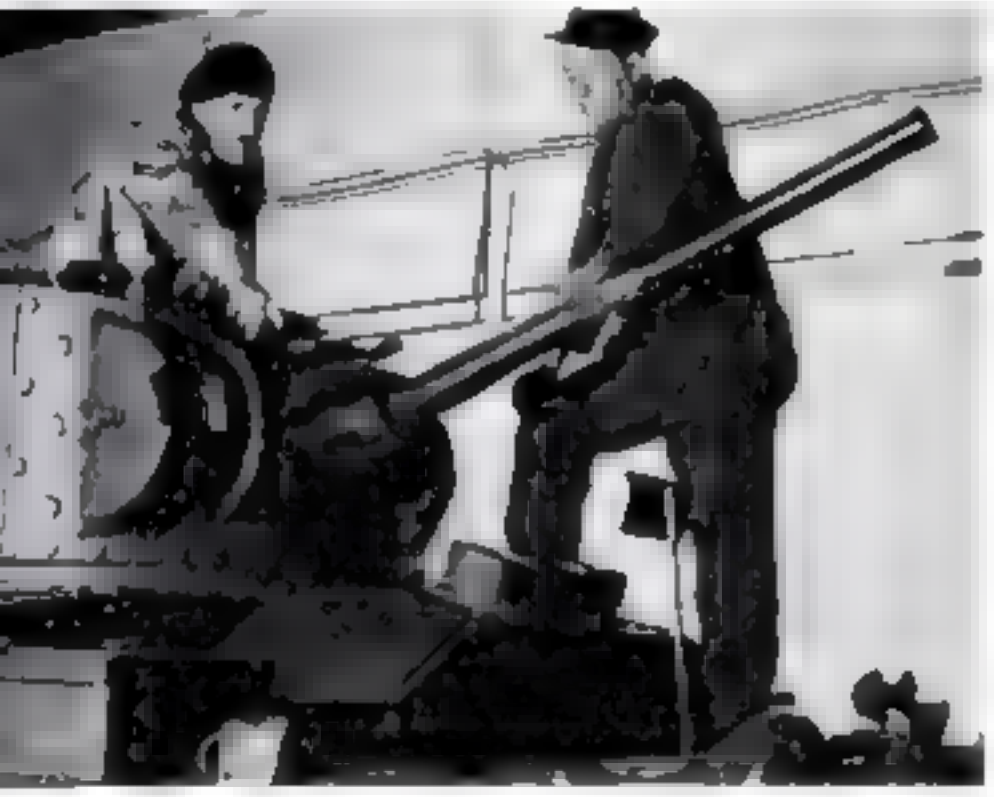
Head man of the air effort is C. G. "Chubby" Power, Minister of National Defense for Air. One of the realists who face the fact that this war is going to be won the hard way, Power says that before it is over half of the Empire's airmen will be Canadians.

The R.C.A.F., a separate organization trained to coöperate with the army and the navy, has an Overseas War Establishment, a Home War Establishment, and—of highest long-range importance—is in charge of the British Commonwealth Air Training Plan.

The Air Training Plan, started three months after the war began, was launched to train air crews from all over the Empire in Canada. Schools had to be built, flying fields prepared, training planes purchased in the United States because Canada had no production of its own.

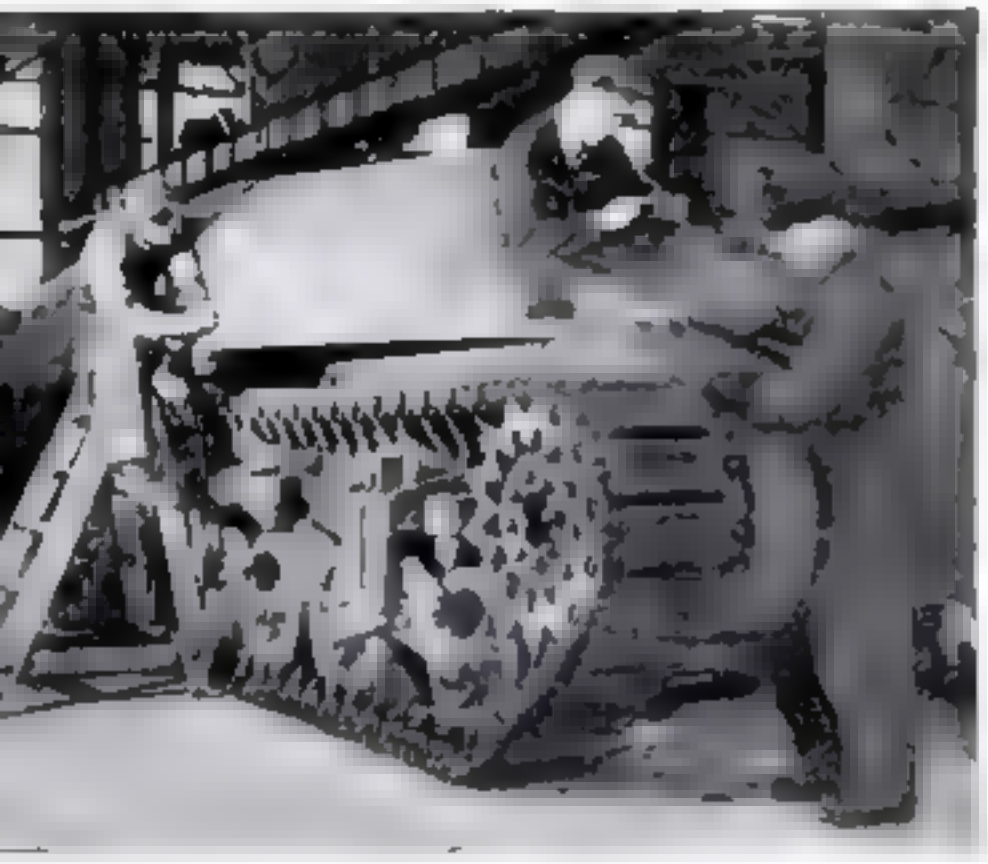
Before the project could get under way, the German blitzkrieg swept across France, and Canada rushed every plane and airman available overseas for the defense of Britain. Despite this delay, the program was pressed and by the fall of 1940 airmen were being turned out, trained and ready to fight, a whole year ahead of schedule!

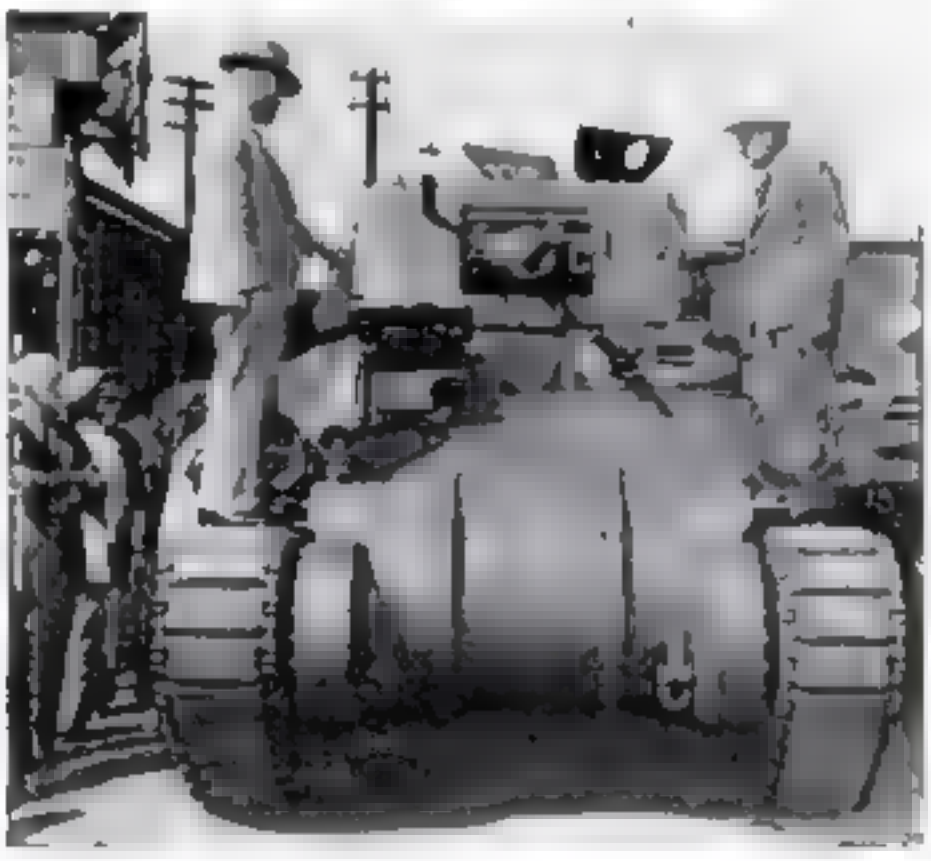
It was a job that took a lot of doing.



Soldier and mechanic meet as a tank reaches the end of the production line. An armored division equipped with Canadian tanks is ready for duty

At left, below, a cruiser tank nears completion at the Montreal Locomotive Works. A novel feature of this Canadian-designed machine, seen finished at right, is cast-steel welded armor without rivets





An R.C.A.F. pilot-instructor watches a student air gunner's work. Canada trains flyers for Australia and New Zealand, as well as her own

the job—every youth in Canada wants to be an airman. Eighty percent of the men trained are Canadians (including the ten or twelve percent of Americans who wear the letters "U.S.A." on their shoulder tabs), ten percent are Australians, eight percent New Zealanders and two percent Britons. South Africa and India have their own air-training systems.

Students first are classified on their capabilities and aptitudes into the three air "trades"—pilot, observer, and radio operator. All are gunners as well.

Initial training is a five-week course at a manning depot, where the recruit learns infantry drill and the ways of the air service, and takes part in conditioning sport. The radio operators next go to a wireless school for a 20-week course, then move on to an air-gunnery school for a month.

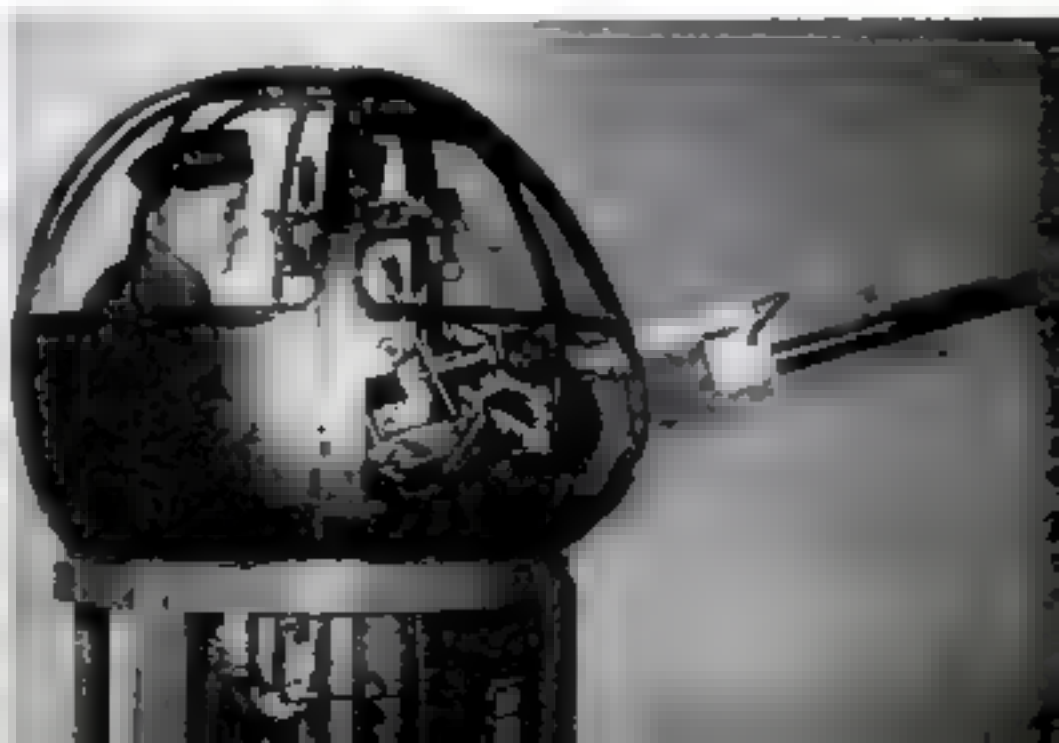
Pilot and observer candidates are sent to an initial training school for five weeks of mathematics, armament and map reading, and on-the-ground flight instruction in Link trainers. Observers get 14 weeks in an air observers' school studying navigation, photography, and aerial reconnaissance, followed by six weeks at a bombing and gunnery school, topped off with another four weeks at an air-navigation school.

The pilot candidates move directly to one of the 26 elementary flying training schools which are operated by civilian aviation companies under R.C.A.F. supervision. The 48-day elementary course comprises theoretical, ground, and flight instruction. First solo flight comes after ten or twelve hours of dual instruction, and at the end of the course the student has had about 50 hours in the air, half of it solo. Next is ten weeks studying aviation theory, maintenance work,

More than 100 air fields were prepared, 90 R.C.A.F. schools and some 40 auxiliary establishments were opened, with the Canadian Government paying the bills for all this construction.

Getting recruits was the easiest part of

"The milkman" comes around to fill the racks of a Fairey Battle for a training flight at the R.C.A.F. bombing and gunnery school at Jarvis, Ontario. At right, below, a student gunner gets a workout in a turret trainer, firing a beam gun at a model plane. Pilots, observers, and radio men must be gunners too



advanced, night and instrument flying, cross-country navigation, and air gunnery at one of the 16 service flying training schools.

Twenty-two weeks after starting at the initial training school, the pilot who passes the course has his wings—the observer and radio operator the single-winged insignia of their "trades." Fast going, but this essential wartime speed hasn't been achieved at the cost of sacrificing lives. Although some of the schools send planes up as rapidly as every 25 seconds from dawn to dark, up to September there had been only 31 fatal training accidents. That the training is thorough as well as rapid is shown in frequent assignment of a pilot to his first service job—flying a bomber across the Atlantic!

Very soon after they receive their wings, most of the air-crew men are sent overseas, for final operational training in fighter aircraft. Most Canadians are convinced that in this war air power is all-important—both to disrupt German industrial effort and to soften up German civilian morale by big-scale bombing, and to overcome the Luftwaffe in the air as an essential prelude to offensive action on land.

And Canada is ready for land action, too. Since the war started, the Dominion has raised its army from less than 60,000 regulars and militiamen to well over 400,000, about 230,000 volunteers for the duration to fight anywhere, and 170,000 in a reserve army. Three divisions, over 100,000 in all, are serving in Britain under Lieut. Gen. A. G. L. McNaughton, Canada's top soldier. An armored division has been equipped with Canadian-built tanks—part of the new industrial output—and probably now is on its way overseas.

A Canadian infantry division is a hard-hitting fighting unit: three brigades of in-

Typical of Canada's rapid mastery of the arts of modern war is the manufacture of these two-pounder antitank guns. Every Canadian infantry division has an antitank regiment equipped with 48 of them

In addition to making the guns, the Dominion is training her men to use them in the manner required for meeting Germany's fast panzer divisions. Moved at high speed on its rubber-tired carriage, the piece can be dismounted and prepared for action in a few seconds' time. These artillerymen are being trained at the Petawawa Camp

fantry, a machine-gun battalion, a cavalry regiment mechanized to fight in light tanks and armored cars, three regiments of field artillery with 72 25-pounder guns (which are about the same caliber as U.S. 105's), an antitank regiment with 48 two-pounder guns, and auxiliary troops. On paper it also has a tank brigade, but only one of these is in actual service and other units will be formed as rapidly as factories turn out the armored vehicles.

A highly important piece of equipment is the Canadian-built Universal carrier powered by a Ford V8 engine—a fast, agile, lightly armored tractor on whose mounts a Bren light machine gun may be used either as an antiaircraft weapon or against ground troops. It also carries a .55 caliber antitank magazine rifle which can be fired either from the vehicle or on the ground.

In battle, the carriers' job is to get the Bren guns and their crews into action in a hurry and with minimum casualties; that done, they scoot for the nearest cover. On marches they are used for general transportation like any tractors.

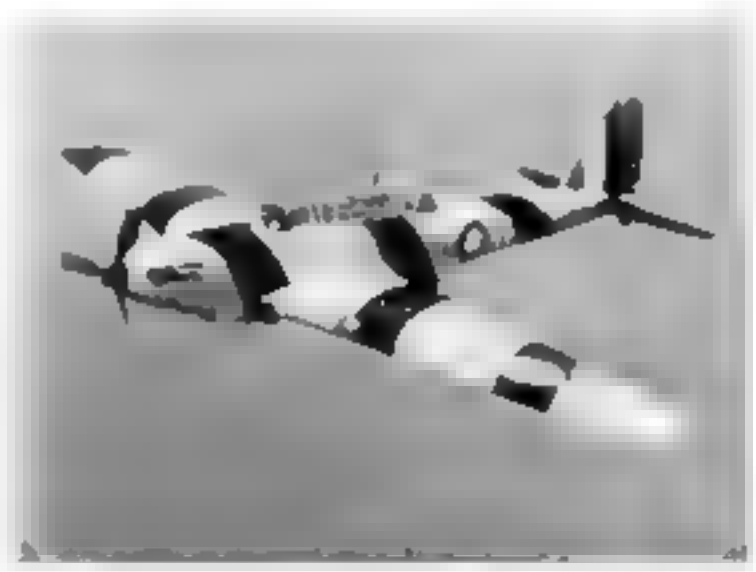
The Bren gun is the principal infantry weapon; each section of nine men has one. Most of the men are armed with ten-shot bolt-action Lee-Enfield rifles, and carry hand grenades. Two-inch mortars also are used, and every man must know how to handle every infantry weapon.

In the camps which I visited the brown faces under the tin hats looked rather more serious than our soldiers' faces do—several younger officers were on "24-hour notice" to report at embarkation depots. The troops were as well cared for as ours, but it was plain that less money had been spent on nonessentials. The food was excellent. So were the bathing and sanitary arrangements. Recreational facilities were rough-and-ready but adequate. Discipline was noticeably good and obviously not harsh.

Recently, recruiting for the Active Service Army has slowed down, but army officers believe this lack of enthusiasm is due to the Canadian Corps' bad luck in not getting into any fighting overseas. As soon as the shooting starts, they think, there will be a flood of volunteers. They back up their opinion by pointing out that the air force and navy, which are fighting now, have no recruiting problems.

The navy, *is* fighting, though little official information is released. When the war started, Canada's navy consisted of 13 ships and 3,600 men. Now there are over 20,000 men, all of them volunteers, manning more than 200 warcraft including destroyers, armed merchant cruisers, and the new corvettes—destroyerlike vessels used for convoy and patrol service—minesweepers, converted yachts, and other small antisubmarine craft. By next March there will be more than 400 ships and 27,000 men in the service. The Canadian Navy, up to early October, had a long casualty list, with 420 dead.

To furnish adequate food, clothing, and materiel to her armed forces, Canada has made every possible use of machinery and manpower. Clarence Decatur Howe, the American-born Minister of Munitions and Supplies, has directed the gigantic task. Except for one plant which had just started to produce Bren guns, the country had no munitions industry when the war began. Aircraft production was insignificant, and only 1,500 workers were employed in shipyards. Today, following a $500,000,000 investment in new equipment, a Government training program, and a subcontracting system which allows not a single machine tool to be idle, 11½ million people have almost reached their potential limit of production.



Bombing on the Great Lakes: Flying low over Lake Erie, a Fairey Battle hunts buoy targets for her bombardier-in-training to hit

I was allowed to see a few of the significant items which compose this huge pattern. Infantry tanks of British design were rolling off the production line in a former railroad shop. Another plant was making 28-ton cruiser tanks of Canadian design, with cast-steel welded armor which needs no rivets. Canada's top scientists and research men were working on war tasks in the laboratories of the National Research Council. Thousands of women and girls made Bren guns in an Ontario plant which has the largest output of any automatic gun plant in the world. Bofors antiaircraft guns were produced in an elevator factory—by the same men who used to build elevators.

The encouraging fact is that today the people of Canada are convinced that they are doing their best, and that their best will be good enough. Winston Churchill himself is authority for their firm belief that without Canada's war effort the resistance of the British Empire could not be maintained.

Clouds Made To Order

Charles G. Clarke, Twentieth Century-Fox cameraman, demonstrates the use of a transparency mounted in front of the camera to put a desired cloud effect into a movie scene

WORRIES of Hollywood directors over sky effects for outdoor scenes have been ended. A new device enables cameramen to mount transparencies containing photographic images of real clouds in front of their cameras and so "print in" any type of cloud called for by the director.

Charles G. Clarke, Twentieth Century-Fox cameraman, devised the transparencies, which are made from color-corrected negatives shot with a still camera. A transparency containing the desired cloud effect is mounted in a holder 18 inches in front of a camera having a wide-angle lens. The holder does not move when the camera is panned.

The transparency is arranged so that the clouds blend with the composition to be filmed. The bold light from the sky area covered by the transparency prints the clouds on the film negative.

Pick your cloud. Here Clarke and Grover Laube are selecting a suitable effect from among Clarke's cloud file of 30 plates. With the transparency mounted on the frame shown, the camera can be panned

TOMATOES for powdered soup and juice. After being washed and sorted, they will be dehydrated to remove nearly all of the water that makes up 95 percent of the fruit

Now It's

Quick-Dried Foods

Just a Few Years Ago Science Gave Us Quick-Frozen Foods. Now We Have Magic Quick-Drying Processes that Drive Out Bulky Moisture While Leaving in the Flavor and Vitamins

By ALDEN P. ARMAGNAC

A BUCKETFUL of dewy, fresh tomatoes goes into a stainless-metal cooker. Less than 30 minutes later, those same tomatoes emerge from a steam-heated drum in a crisp sheet resembling red crepe paper, ready to be ground into tiny flakes and packaged. An industrial miracle has transformed a fruit that is 95 percent water into practically dry form, compact and imperishable, while retaining its tempting aroma, its savory flavor, its nourishing value, and its healthful vitamins. Simply add hot water, and it becomes delicious tomato soup.

This is dehydrated food, 1942 model. Unlike dried soup mixes and other products you may have bought at grocery stores in the past, new preparations have been so completely wrung free of moisture that they will never return to their original form. Instead, you may turn powdered flakes into cranberry jelly. Clam "pennies," now on the market, dissolve in boiling water to make clam broth. Tasty drinks—lemonade, orangeade, limeade—come in concentrated powders for home or medical use. Bananas and pumpkins are reduced to vitamin-rich flakes, to be eaten with cereals or used in cooking. Bright yellow grains of dehydrated molasses serve in making gingerbread. Chili con carne and mushroom salt are novelties on the growing list. Still in the experimental stage, a capsuleful of powdered oyster—one of the most elusive flavors to retain—needs only to be dropped into hot milk to make an oyster stew for three. Products such as these represent, perhaps, the nearest approach so far to often-predicted "tablet meals" of the future.

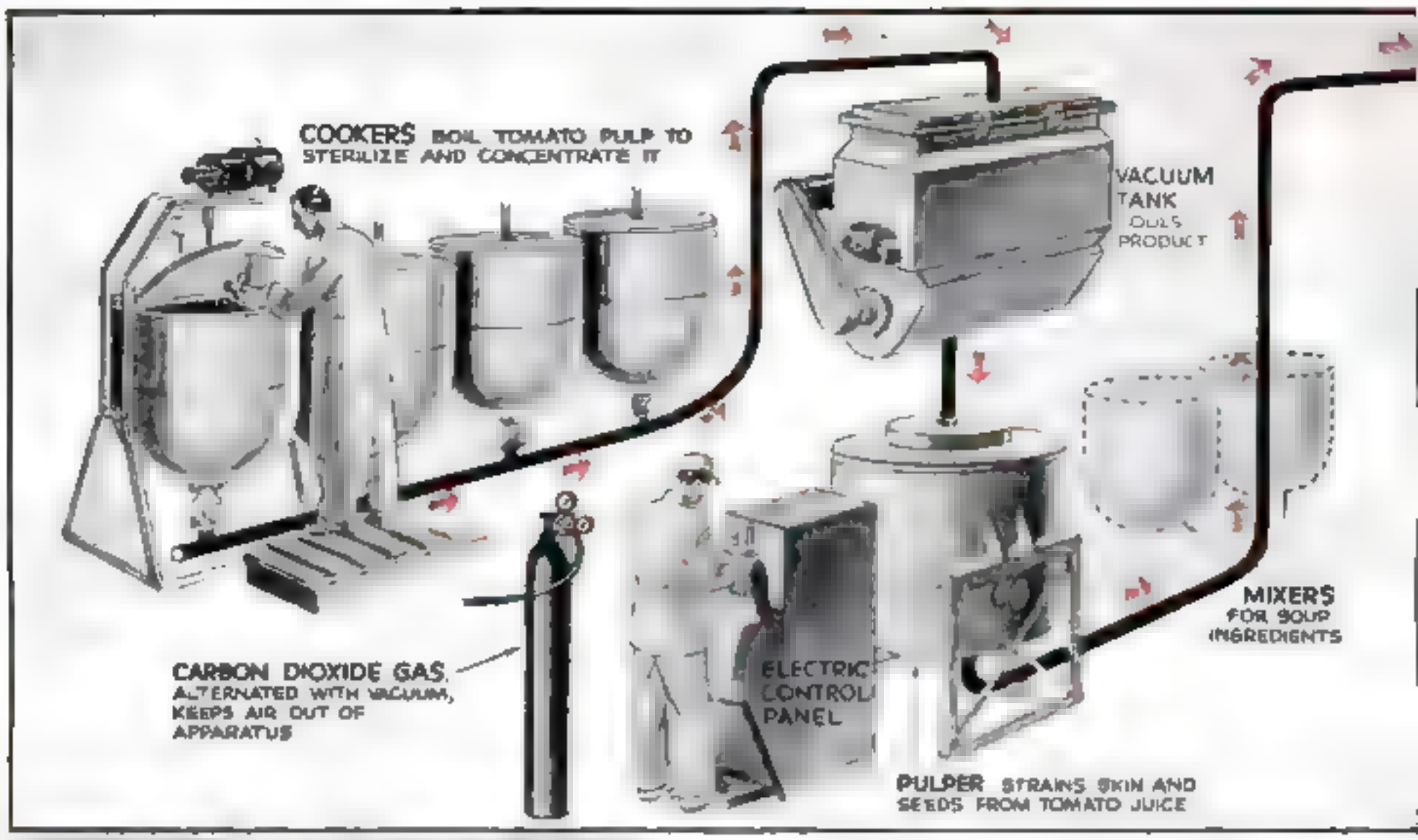
Will the super-concentrated foods prove popular with the general public? With dehydration plants situated in the midst of growing areas, enormous savings in the cost of transporting the products, because of their reduced bulk and weight, should make them salable at attractive prices. But manufacturers are not worrying overmuch about the verdict of conservative housewives. More promising markets beckon.

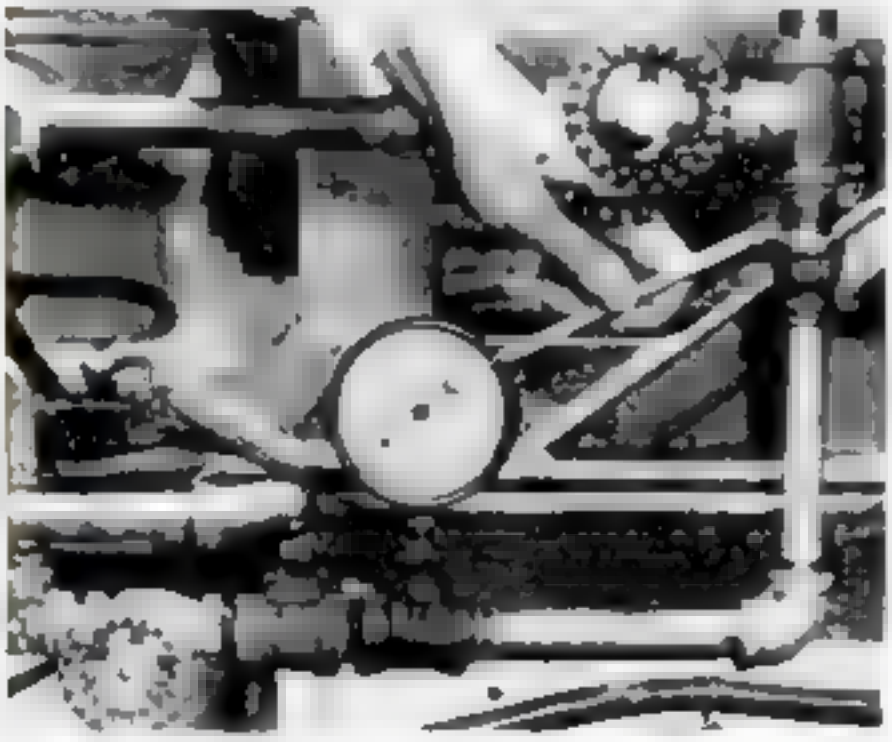
Huge stores of dehydrated foods are being laid in by the U. S. Army and Navy, since they will keep indefinitely without refrigeration. During the fiscal year that began last July, the Navy alone estimates its requirements in dehydrated vegetables at more than 12,000,000 pounds. Lend-lease aid to Britain calls for eightfold expansion of the dried-egg industry to 100,000,000 pounds a year, with dried milk to follow. A recent Government purchase of more than 1,500,000 pounds of dried eggs corresponded to nearly 6,000,000 eggs in the shell, or 400 carloads.

And the most staggering figures of all will be reached after the war, when the United States plans the greatest relief expedition in history to help feed famine-stricken Europe. Laden down to its Plimsoll mark with dehydrated foods, each ship will be able to carry more than a fleet of six vessels with ordinary food cargoes. To make the food go as far as possible, one executive suggests assortments especially made up for an intended destination; if the

Washed, fresh tomatoes go into one of a battery of steam-jacketed cookers in which they will be boiled down to a paste. Air is excluded by a blanket of carbon dioxide gas, which is later displaced by steam

Color Photographs made at Sardik Food Products Corp. by William Morris





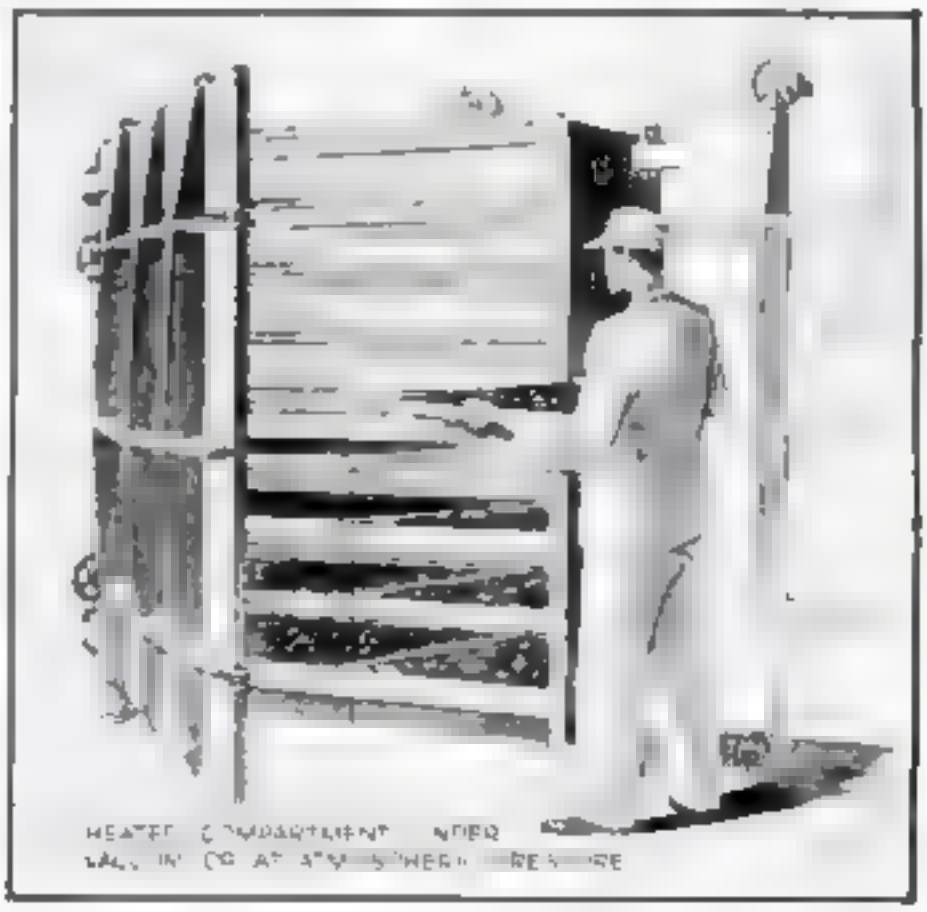
This gauge registers 28 inches of vacuum used to lower the boiling point, exclude air, and move the product through the Sordik system shown above

cabbage crop has been good in one section of a country, for example, food sent to that locality will contain all the body-building vitamins except the ones that cabbage contains.

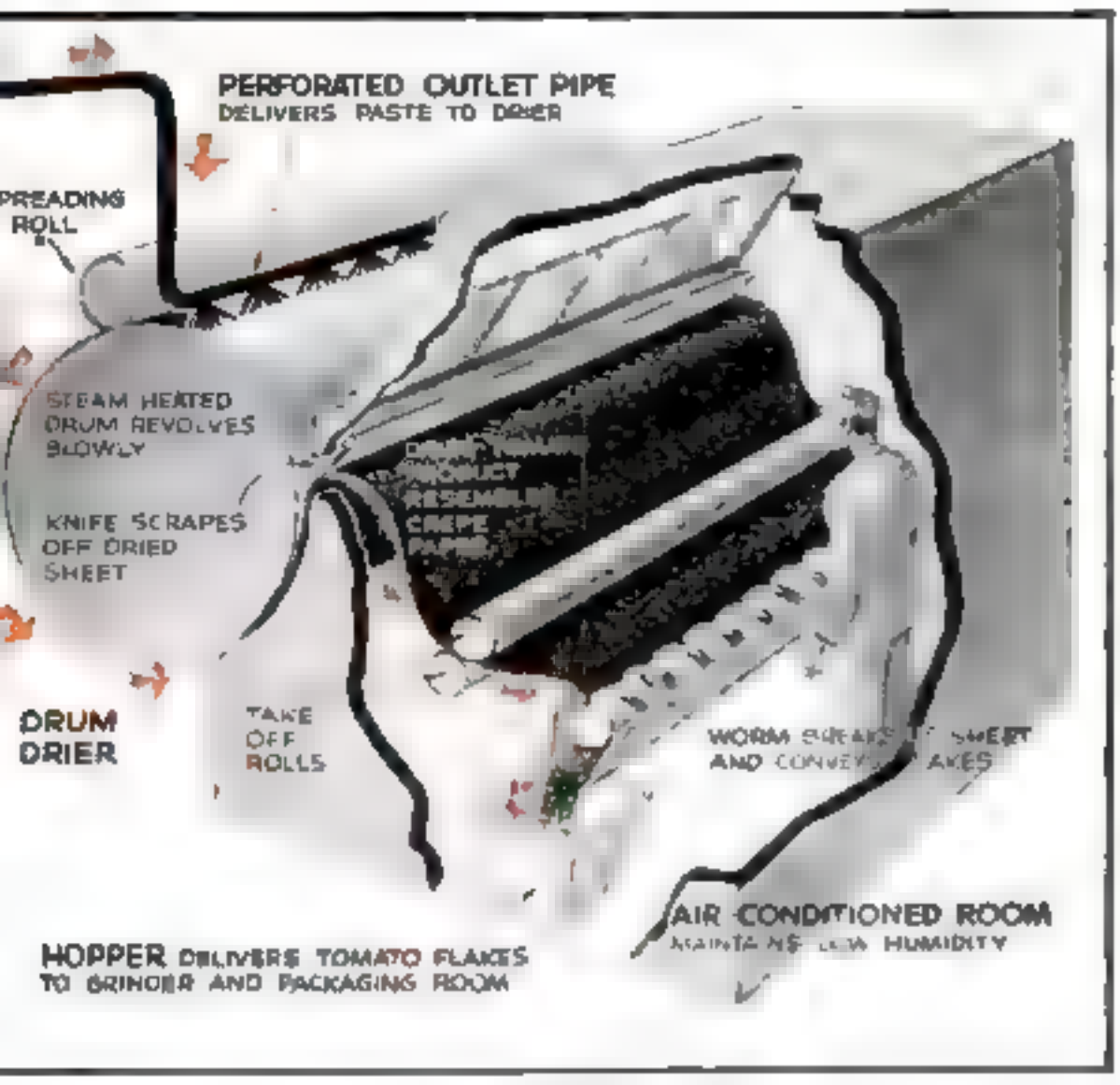
For some food products, such as milk and eggs, dehydration has long been a standard method of preservation, but its successful application to vegetables is something new. Quick-drying processes now rival those of quick freezing, for storing them without detriment to flavor.

If the food to be dried contains much water, the first step is usually to reduce it to a paste. Boiling it down in contact with the air may oxidize it and spoil its taste. So one way out is to fill the boiling vessel with a "shot" of inert carbon dioxide gas, which excludes air until it is replaced by steam. Another scheme is to heat the product in an evaporating vessel under a high vacuum. For foods especially sensitive to ordinary boiling temperature, this has the advantage that a vacuum lowers the boiling point.

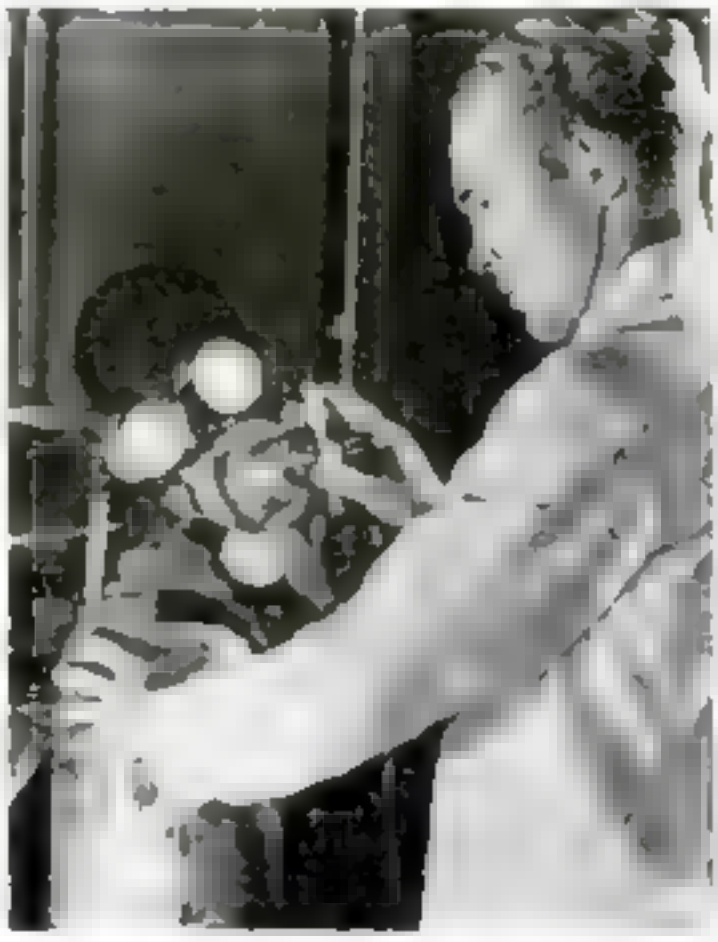
OTHER TYPES OF FOOD DRIERS



SHELF DRIER takes small batches of food to be dried by steam, hot air, or electricity. This is a vacuum type; others work at atmospheric pressure



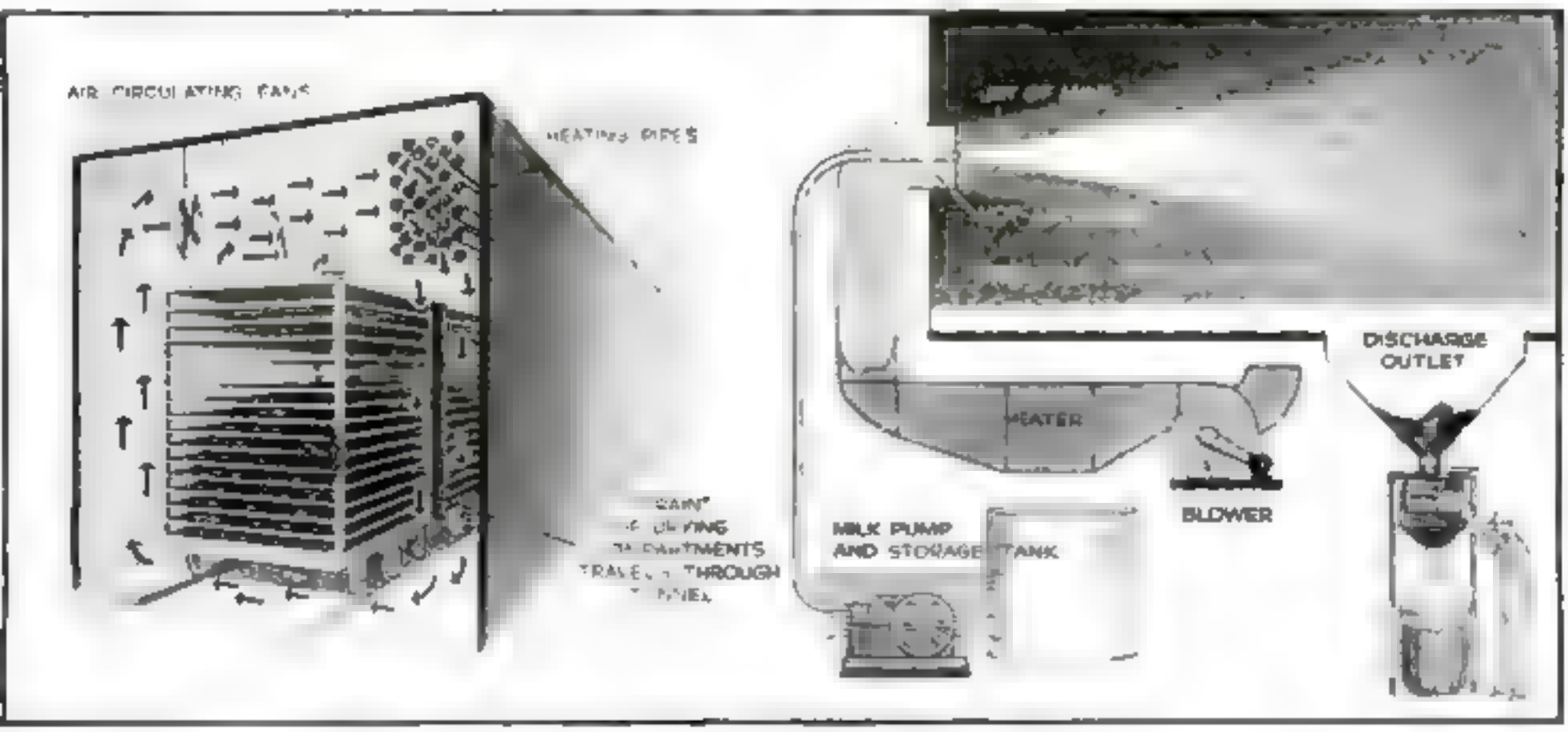
Carbon dioxide gas from this cylinder is shot into the system at various points to exclude air which would cause oxidation and so spoil the flavor of the food



A "colloid mill" developed by Dr. H. D. Pease, New York research expert in nutrition, offers a food-concentrating method in a class by itself. When foods such as clams and oysters are fed into it, special disks whirling at thousands of revolutions a minute reduce them to individual and groups of particles of microscopic dimensions. Almost simultaneously, a starch preparation coats these particles, and a jet of dry steam "toasts" the starch, forming a protective layer that seals in the flavor.

Many foods prepared by these processes, such as oyster puree, are marketed directly in concentrated form. For complete dehydration, however, they go on to a drier,

THAT PUT GOODNESS AND NOURISHMENT IN SMALL SPACE



TUNNEL DRIER. "Trains" of drying compartments roll on tracks through a passageway in which fans circulate heated air around them

SPRAY DRIER is shown above producing powdered milk. Concentric air and milk nozzles atomize preconcentrated milk and dry it almost instantaneously

A thin sheet of dried tomato soup, resembling red crepe paper, enters an air-conditioned room after being scraped off a drum drier. In the middle foreground it may be seen passing under a take-off roll; at bottom, fragments are being carried away by a worm conveyor to be ground up and packaged

which leaves them with only a negligible amount of moisture. Compartment or shelf driers, tunnel driers, spray driers, and drum driers, are some of the most widely used types.

Resembling an oven, the first type of drier accommodates limited batches of nearly any kind of food. Travfuls are dried by heated air, steam, or electric heat. Both atmospheric-pressure and vacuum designs are available.

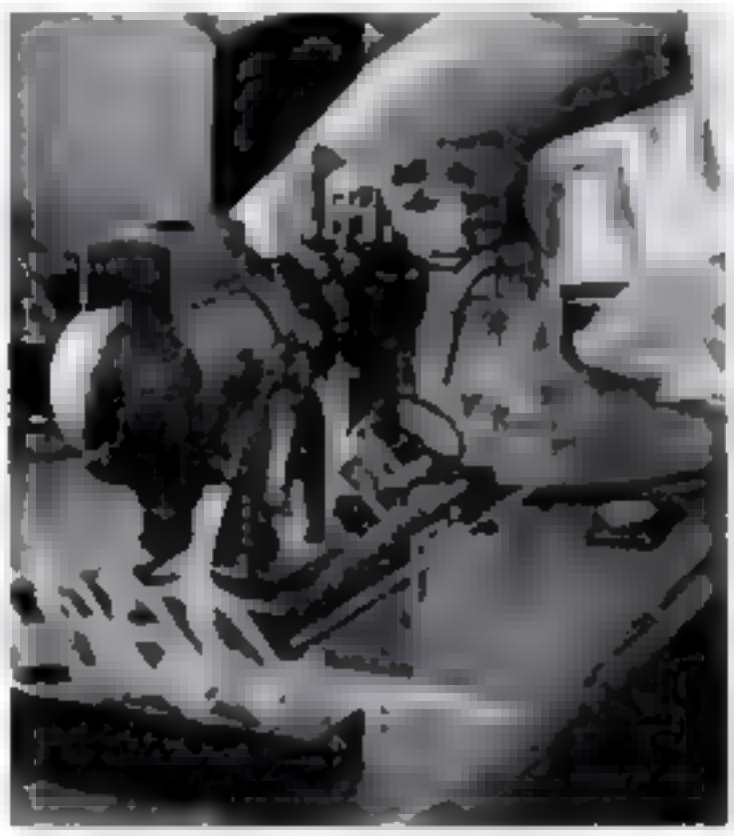
Tunnel driers provide heated passageways through which similar compartments travel on wheels, hooked together in "trains" propelled by a chain and cogs. By the time the food reaches the end of the tunnel, it is thoroughly dehydrated. Fat-free potato wafers that will keep indefinitely have recently been produced with the aid of a tunnel drier. It also is suited to apples, prunes, figs, and other foods that take a long time to dry.

OYSTER STEW in capsule form. Into the little gelatin container at left modern food chemistry has packed the essence of enough oysters to make a quart of rich, full-bodied stew. In use, it is emptied into a quart of hot milk and there you are—and you needn't worry whether there is an "R" in the name of the month. Still in the experimental stage, this product is not yet available commercially

Spray driers find extensive use in making powdered milk. In one of the principal systems, concentric jets of preconcentrated milk and hot air are shot into a dehydrating chamber. Almost instantly atomized and dried, the milk settles as a snowy powder to the floor, where a conveyor moves it to a discharge outlet.

Drum driers, while diverse in design, may be illustrated by the kind developed especially for the Sardik dehydration process. Delivered from a perforated pipe, a food paste is spread in a thin layer on the outer surface of a steam-heated, revolving metal drum. As the drum slowly turns, the product travels with it, protected from the air by its own steam. Before the food layer completes one revolution, a knife scrapes it from the drum in the form of a crisp sheet resembling paper, which is then broken up and ground. If 100 pounds of tomatoes pass through the process, they are transformed into 5½ to six pounds of dry flakes. When the product is to be tomato soup, mixing tanks add milk, spices, and other ingredients before the blend reaches the drum drier. Disconnect the mixing tanks from the "production line," and the product will be dried tomato juice.

Even after taking all modern precautions, how can a maker be sure that precious but fugitive vitamins have survived his process? Formerly a vitamin test might require a three-week trial of diets on laboratory rats. Today, with the aid of a compact instrument called a fluorophotometer, the same test takes only eight hours. And most of this time is spent in preparing the sample to be examined. Once the chemical operations to isolate the vitamin have been completed, only a few moments suffice to measure out a specimen with a pipette into a transparent, flat-walled container called a cuvette. When this is inserted in the fluorophotometer, it intercepts a beam of invisible, ultraviolet rays from a built-in electric lamp.



Inserting a sample in the fluorophotometer, an instrument that cuts vitamin testing from three weeks to eight hours

If the vitamin being tested for is present, it will glow or fluoresce under the black light. The brightness of the glow shows the amount of vitamin. But the precision instrument does not rely upon human eyes. Instead, an electric-eye arrangement gives a precise reading upon a scale, for the operator to jot down. Interchangeable screens adapt the device to test for any given vitamin. Thus it guards quality and prevents waste in large-scale production, by permitting a constant check upon delicate temperature and pressure adjustments of the process. Perhaps better than anything else, this little black instrument with silvery trimmings typifies the substitution of scientific knowledge for guesswork in the modern manufacture of dehydrated food.

Raw material and finished product: the can contains dry tomato-juice flakes. By adding milk and other ingredients at one stage of the process, tomato-soup flakes are made

Here's My Story

TODAY, JOHN HAYS HAMMOND, JR., IS ONE OF AMERICA'S FOREMOST INVENTORS

1 FIVE YEARS AFTER HIS BIRTH IN SAN FRANCISCO, CALIF., APRIL 13, 1888, JOHN HAYS HAMMOND, JR., TRAVELED TO AFRICA WITH HIS FAMOUS MINING-ENGINEER FATHER, WHO WAS ASSOCIATED WITH CECIL RHODES

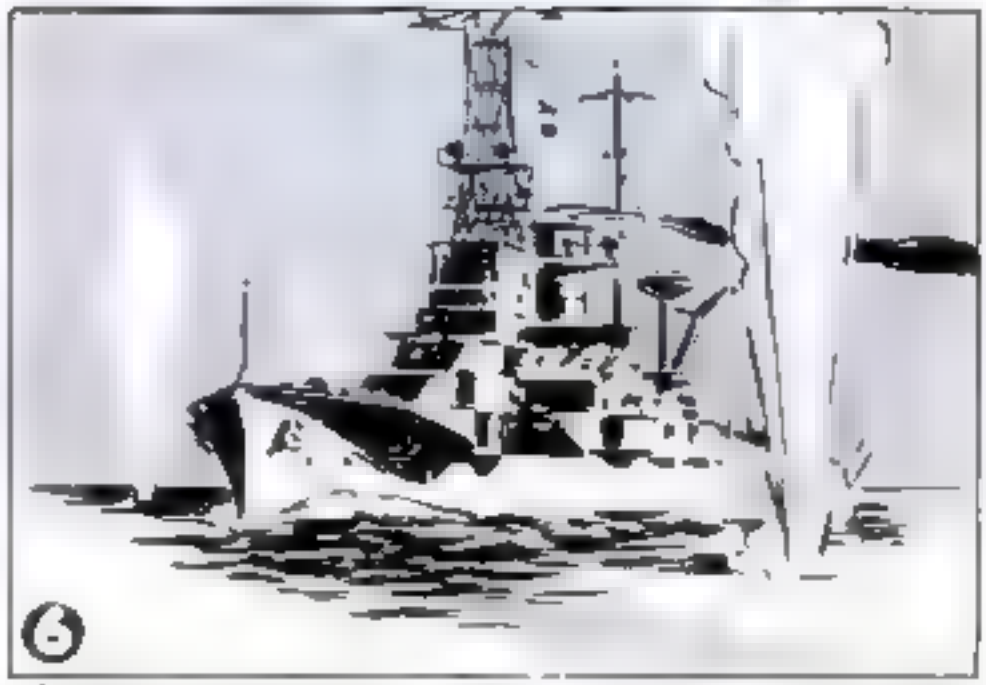
2 AFTER HIS RETURN TO AMERICA, H S MOTHER GAVE HIM AN EXPENSIVE SWISS WATCH. AN HOUR LATER, SHE FOUND HIM IN H S ROOM, WATCH PARTS LAID OUT ON THE FLOOR, TRYING TO IMPROVE THE MECHANISM

4 HE APPLIED FOR HIS FIRST PATENT ON A NEW-TYPE PUMP AT 18. HE FOUND ANOTHER MAN HAD THE SAME IDEA. THEY FORMED A COMPANY TO MANUFACTURE THE PUMP. THE COMPANY WENT BROKE

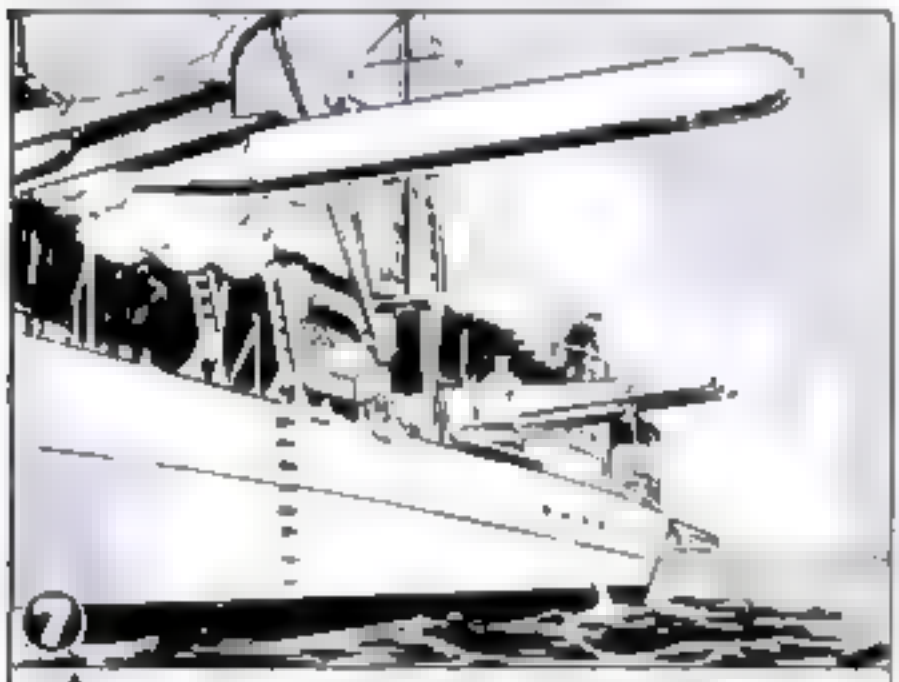
3 WHEN HE WAS 12, HE WENT WITH HIS FATHER TO VIS T THOMAS A. EDISON IN HIS EAST ORANGE, N.J. LABORATORY. EDISON GAVE HIM SOME OF THE OR GINAL DRAWINGS OF THE PHONOGRAPH. THE BOY WENT HOME DETERMINED TO BE AN INVENTOR

THE CAREER OF JOHN HAYS HAMMOND, JR.

After graduation from Sheffield Scientific School at Yale, in 1910, he spent seven years in a private laboratory at Gloucester, Mass., perfecting wireless control of ships

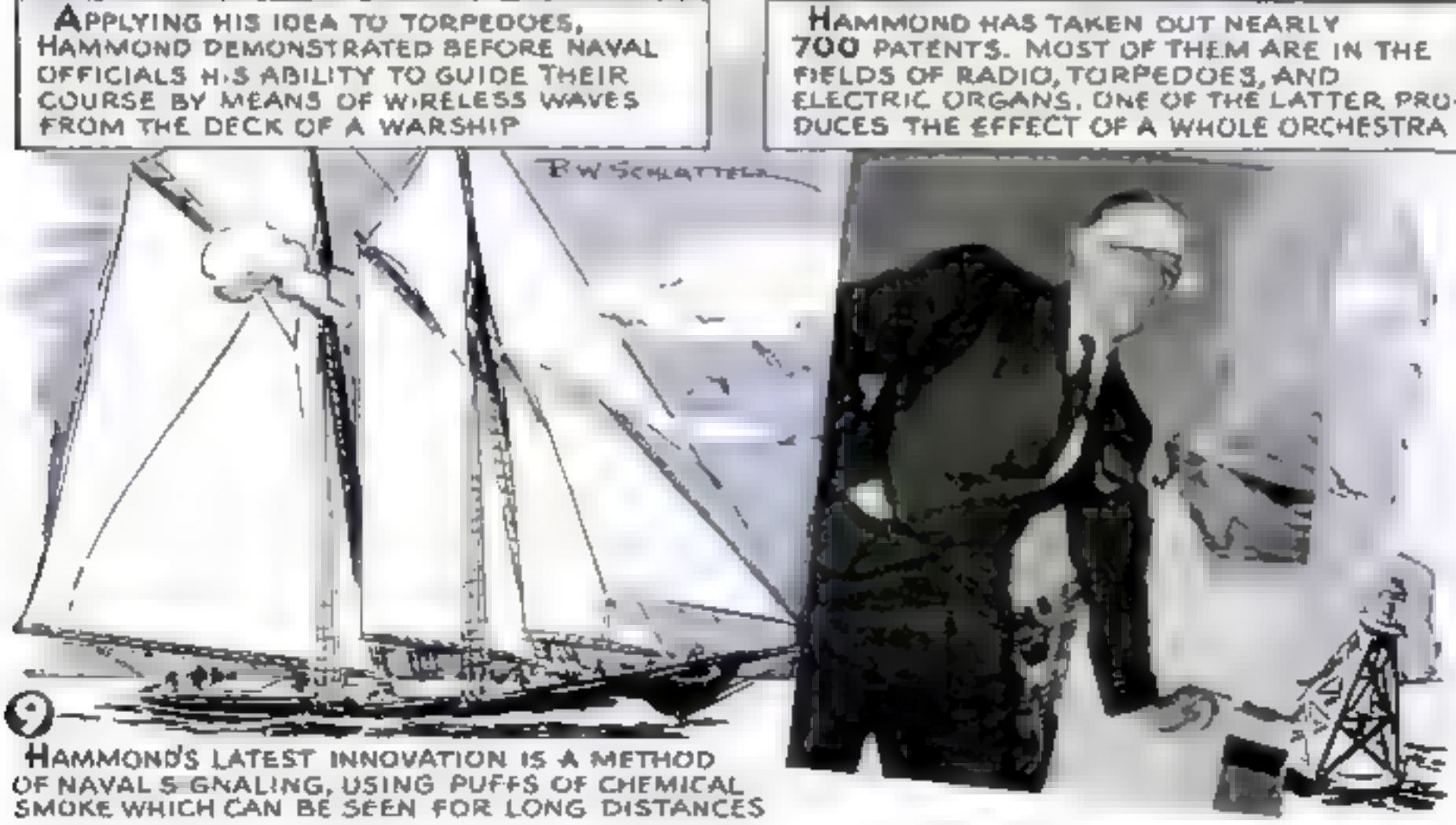


Using three obsolete warships, the U.S. Navy tested Hammond's invention in target practice. The inventor has 120 patents on his radio ship-control system



Applying his idea to torpedoes, Hammond demonstrated before naval officials his ability to guide their course by means of wireless waves from the deck of a warship

Hammond has taken out nearly 700 patents. Most of them are in the fields of radio, torpedoes, and electric organs. One of the latter produces the effect of a whole orchestra



Hammond's latest innovation is a method of naval signaling, using puffs of chemical smoke which can be seen for long distances

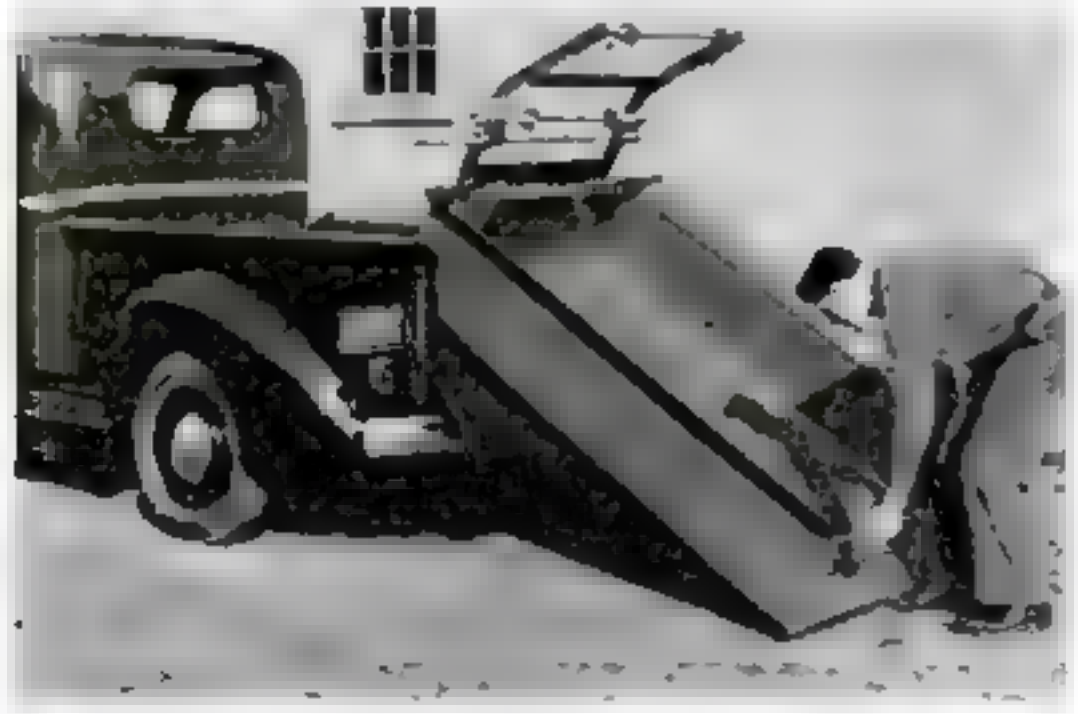
Tiny Ball Bearings for Model Makers

TINY miniature ball bearings so small that they make a house fly look like a giant are now readily available. Developed originally for use in precision industrial instruments, they fulfill exacting demands of model builders. The smallest of the radial bearings is one of .040" bore, with ¼" outside diameter, 3/64" width, and eight balls of 1/32" diameter. Other sizes range up to 3/32" bore with ten balls of 1/16".

Power-Driven Scraper Designed for Shops, Chips Off Floor Dirt

A FLOOR SCRAPER, combining the familiar hand ice-scraper and a portable hammer, removes thick and hard accumulations from industrial floors in paint and machine shops, garages, foundries, and forge shops. The operator, instead of laboriously hand-scraping the floor, slides the tool along and the vibrations transmitted from the hammer on the handle to the cleaning point chip and clear all dirt bound to the floor. Power may be pneumatic or electric. In a test, an inexperienced user removed two barrows of dirt from a forge-shop floor in a day's work.

Above, the floor scraper with its power-driven hammer. Right, in use

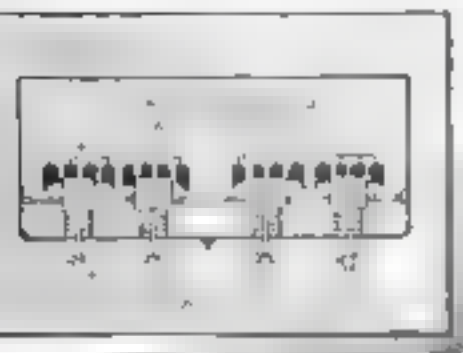


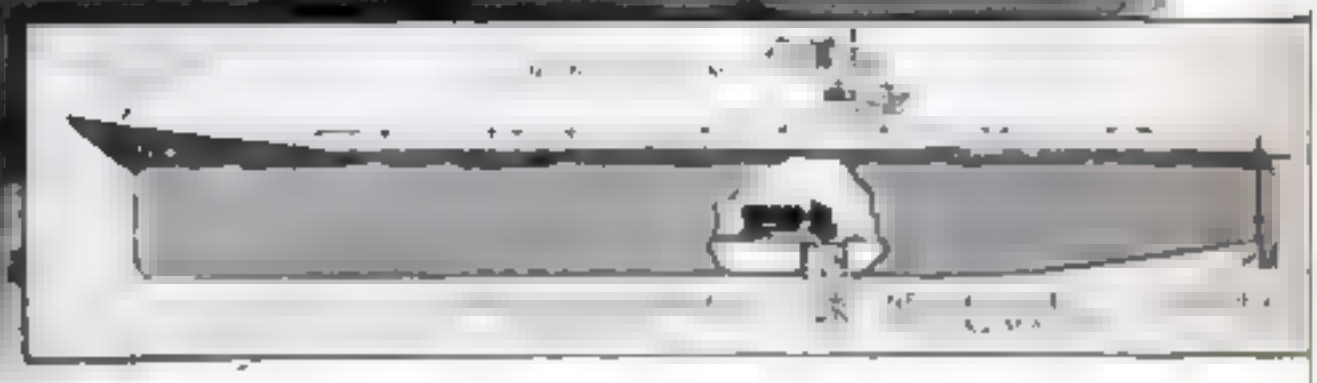
It takes two minutes to mount this dump-truck unit on a pick-up truck. It may be hand, hand-hydraulic, or engine operated

Unit Makes Dump Truck of Pick-Up Vehicle

SLIP-IN units, installed or removed in two minutes, convert pick-up or platform trucks into dump trucks. The attachment is self-contained, requires no drilling of holes for bolts, nuts, or other fastenings, and is made for use in ½, ¾, and one-ton pick-up vehicles and any size of platform truck. Light enough to be installed by one person, it is available with the hoist operated manually, by a hand-hydraulic pump, or by power from the fan belt of the engine.

How the new Sea Otters will appear on the high seas. A dozen men can operate one easily. Note the 16 auto engines (insets) for four propellers



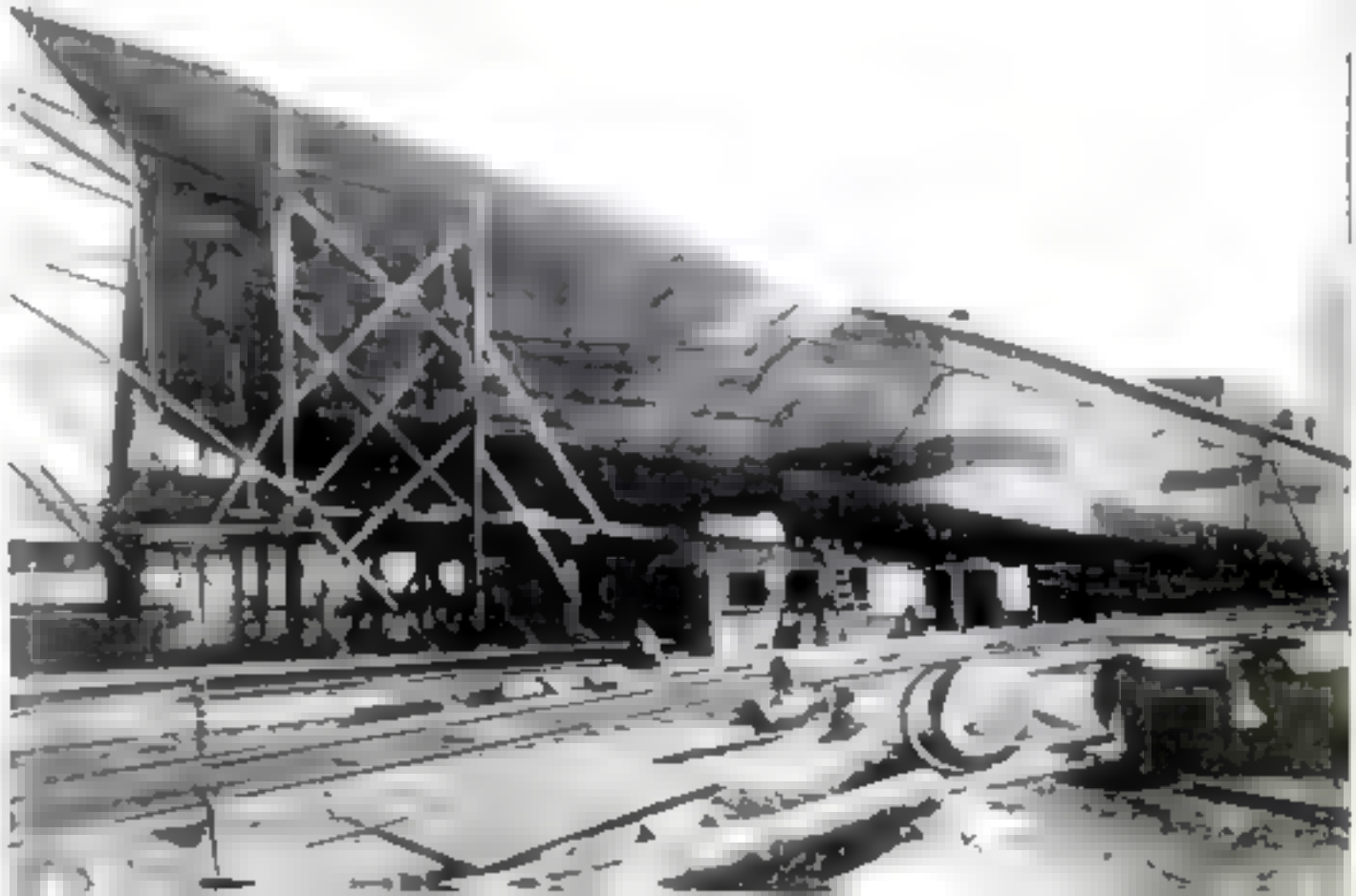


Squat New Armed Cargo Ship Is Powered by 16 Auto Motors

CALLED "Sea Otters" because they suggest an animal swimming with only its head out of water, armed cargo ships of unprecedented design are planned for mass production in U. S. yards, to carry lease-lend aid abroad. Each 270-foot vessel draws only 10 feet of water and its decks are awash in all but the calmest sea, making it the worst possible target for torpedoes and gunfire. Under way, it sounds like a fleet of motorboats, for it is driven by 16 automobile engines totaling 1,700 horsepower.

The ship will trail no telltale smoke. A crew of only 12 men operates it from a structure resembling a conning tower, which is surmounted by a gun for protection against airplanes and small surface raiders. Below decks, capacious holds forward and aft accommodate 1,500 tons of cargo. Government officials estimate that a Sea Otter can be built in less than two months, and their shallow draft permits the use of inland shipyards.

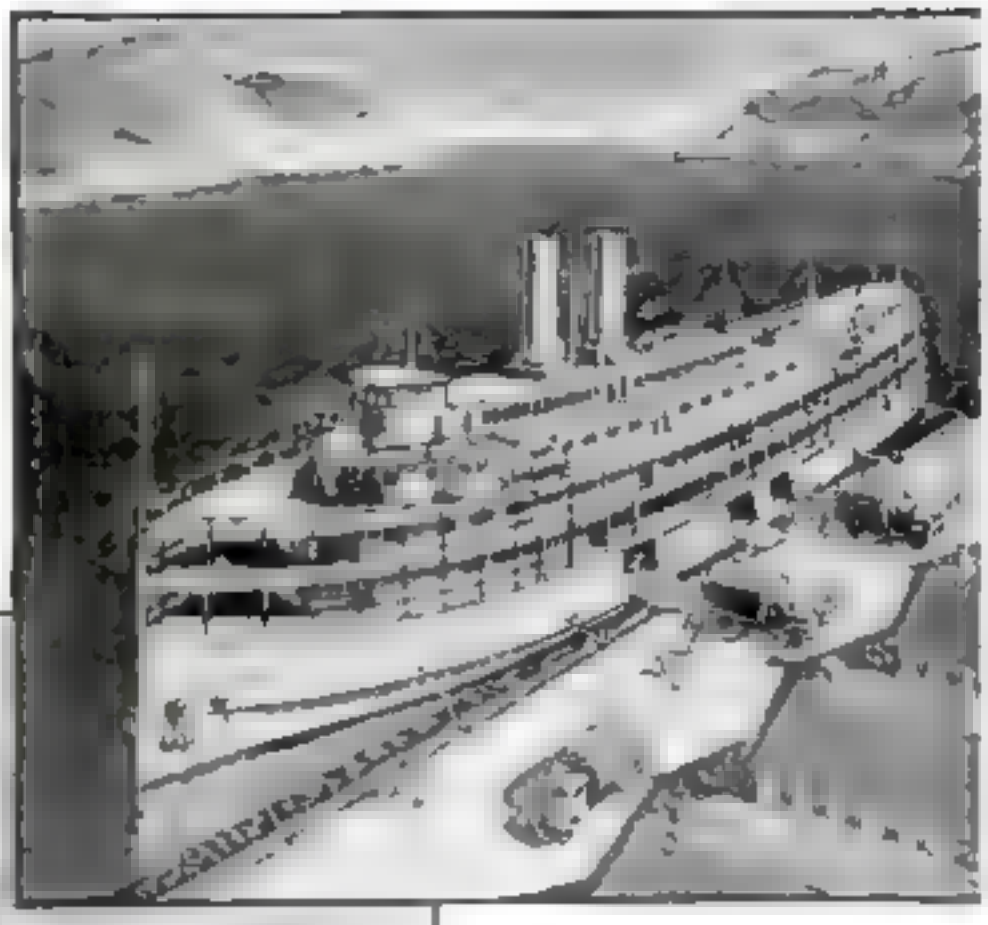
The designers sliced months from planning of the ships by selecting gasoline engines available from automobile production lines to power them. The motors are arranged in groups of four, each of these groups being coupled through gears and shafts to one of the four six-foot propellers, mounted amidships instead of astern. Readily available materials, employed throughout, include stacks of inflated automobile tires for the propeller-shaft bearings.



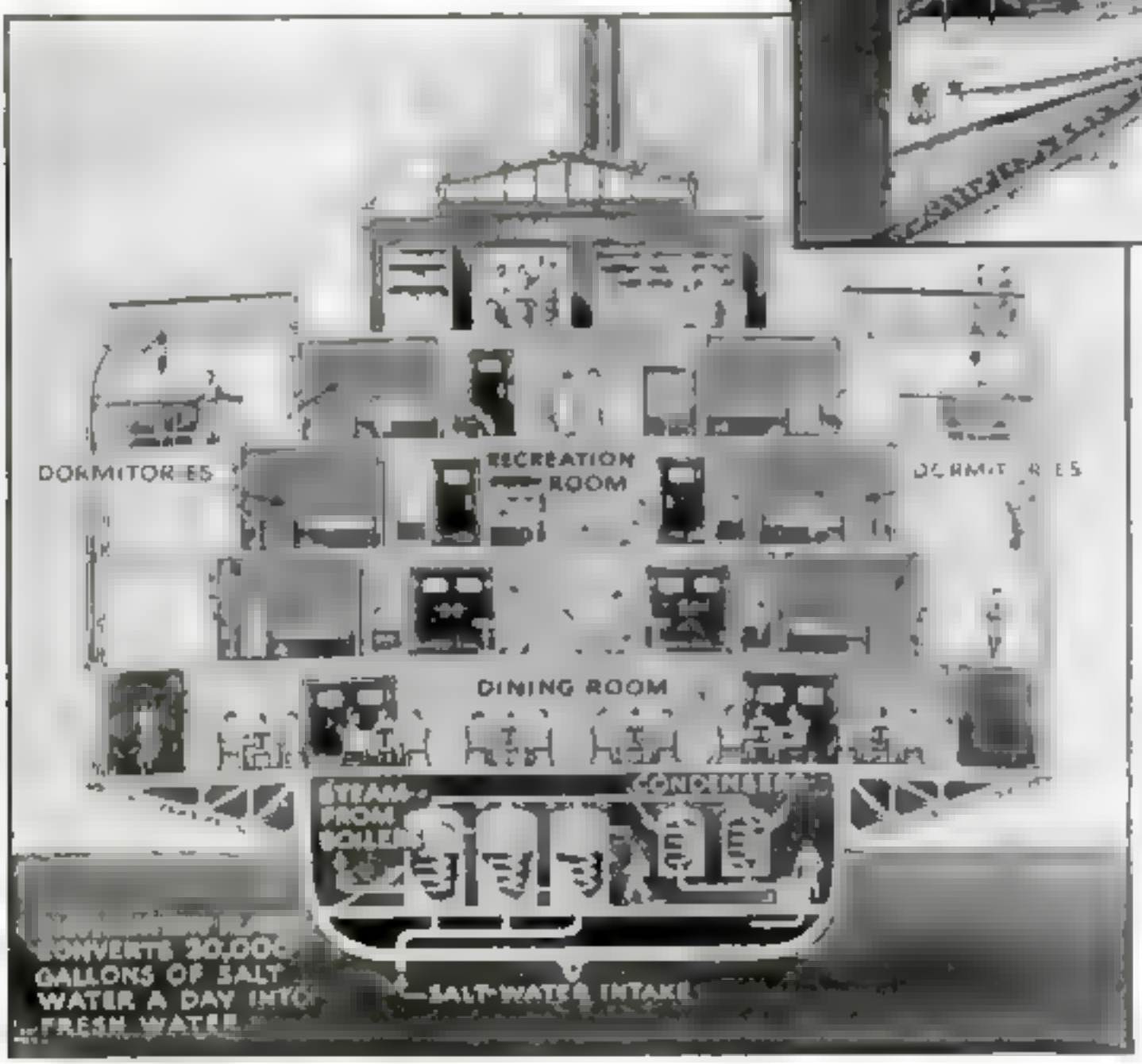
"Sea Otter No. 2," first full-size ship (270 feet) of the class, on the ways at Orange, Tex., prior to her launching. Her predecessor was an 80-foot model. She carries 1,500 tons and provides a poor target

Converted Excursion Boat Houses Workers at Defense Base

ONCE a gay excursion boat of the Hudson River Night Line, the converted S. S. *Berkshire* now serves as a floating dormitory and commissary for workmen at one of the outlying bases that the Army is developing for hemisphere defense. Made seaworthy and towed to its destination, it has solved the problem of adequate housing, meals, and fresh water. For the last purpose, a distillation plant was installed to turn 20,000 gallons of salt water into fresh water daily.



Landing workers and supplies from a converted steamer that will provide living quarters for the men, making it unnecessary to put up temporary buildings. The boat was towed to the site



At left is a sectional view of the vessel to show how it has been adapted to its novel use. The distillation plant will provide a supply of fresh water for the workers, who live in dormitories

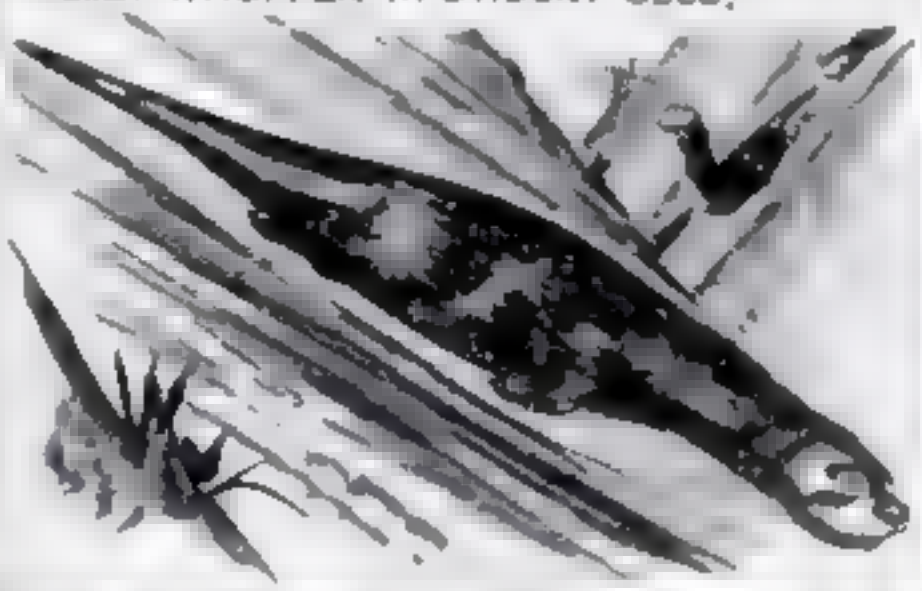
Rare Trumpeter Swans Saved from Threatened Extinction

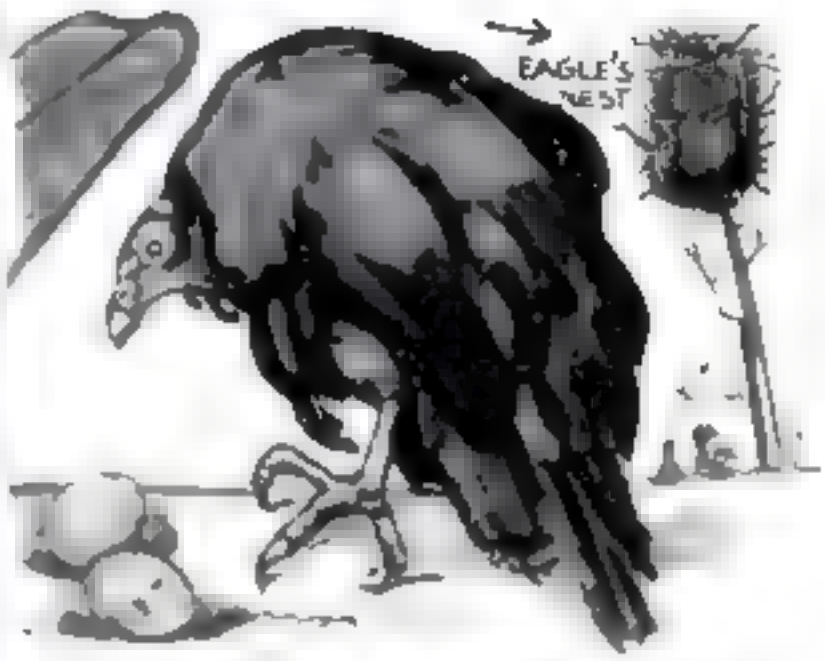
TRUMPETER SWANS like the one shown at left, probably the rarest of American birds, are barely being saved from extinction. Their entire population has increased in a year from 190 to 211, according to surveys of the U. S. Fish and Wildlife Service. During the breeding season, the handsome birds congregate at Red Rock Lakes National Wildlife Refuge, Montana, and Yellowstone National Park, Wyoming. Conservationists appeal to hunters not to mistake them for snow geese, which are smaller in size.

Un-Natural History

BY Gus Mager

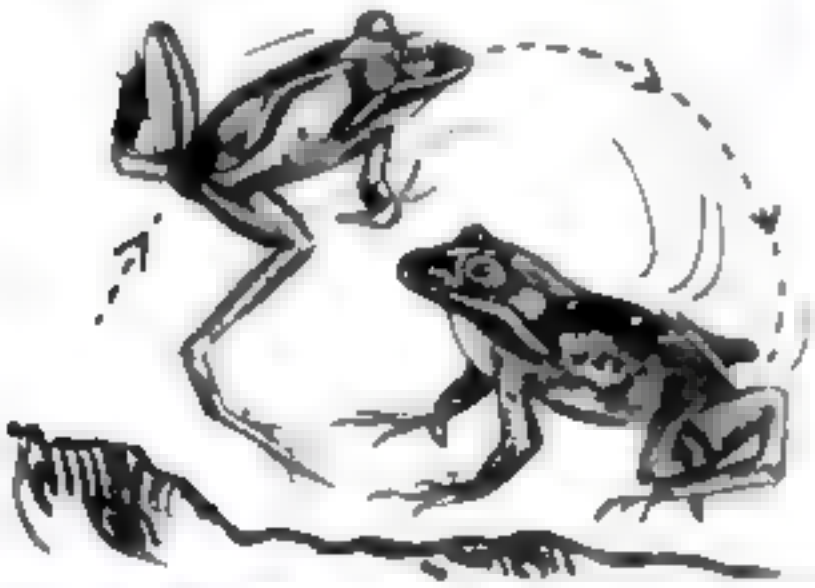
PLAYFUL **OTTERS** INVENTED THE CHUTE-THE-CHUTES! IN WINTER THEY SLIDE DOWN SNOWBANKS INTO THE WATER, IN SUMMER, THEY CAREFULLY CLEAR MUD BANKS, WET THEM DOWN, AND SLIDE DOWN BELLY-WHOPPER IN EVIDENT GLEE!

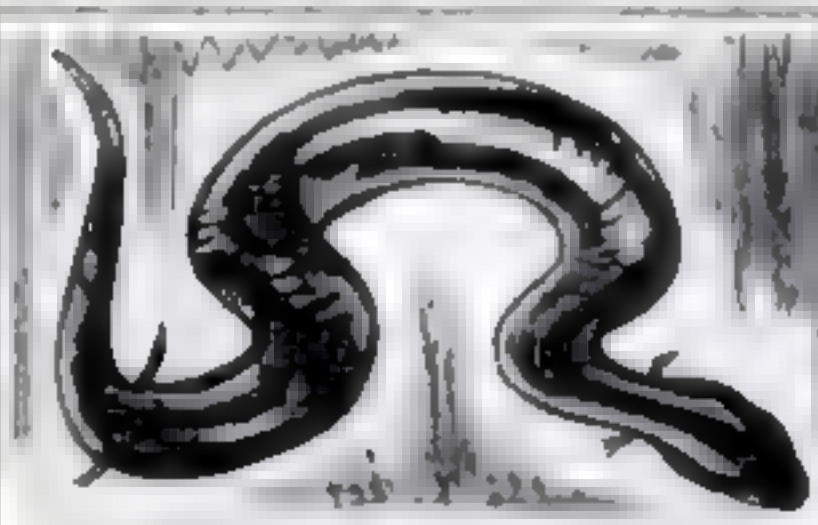




WHILE EAGLES AND HAWKS BUILD BIG, TOP-HEAVY NESTS, **VULTURES** CARE NOTHING FOR HOUSEKEEPING! THEY USUALLY BUILD NO NESTS, BUT DEPOSIT THEIR EGGS IN CAVES, TREE HOLLOWS, OR EVEN ON THE BARE GROUND!

UNLIKE MOST OTHER FROGS, THE **WOOD FROG** IS A LANDLUBBER! ANOTHER QUEER THING: IN JUMPING AWAY FROM AN ENEMY, HE TURNS IN MID-AIR AND LANDS FACING TOWARD THE DANGER!





THE **CONGER EEL**, FOUND IN MUDDY STREAMS AND SWAMPS IN THE SOUTH, IS NOT AN EEL BUT A SALAMANDER. IT GROWS UP TO THREE FEET LONG, AND LOOKS LIKE AN EEL— BUT IT HAS FOUR TINY FEET, AND THAT SETTLES IT!

CROCODILES DO SHED TEARS WHEN SNATCHING THEIR HELPLESS VICTIMS! HOWEVER, THEY DON'T WEEP FROM PRETENDED SYMPATHY AS SUGGESTED BY THE SAYING "CROCODILE TEARS," BUT BECAUSE THE PRESSURE OF FOOD AGAINST THE ROOF OF THE MOUTH SQUEEZES THE TEAR GLANDS!

LATEST INSECT MENACE IS THE **WHITE-FRINGED BEETLE**, INFESTING OUR GULF STATES FROM SOUTH AMERICA! THEY ARE ALL EGG-LAYING FEMALES, REPRODUCING BY PARTHENOGENESIS! NO MALES HAVE EVER BEEN FOUND!

Americans Take to Tanks...

Like Ducks to Water

Years of Tinkering with the Family Car Have Made Today's Soldiers "Naturals" at the Technique of Mechanized War

THOSE folks who have been squawking about bad morale in the Army would do well to visit some outfit of the 2nd Armored Division. It would reassure them, for instance, to come up with the 2nd Battalion, 66th Armored Regiment, bivouacking in the piney woods down south. Certainly it would do their spirits good to meet Private (Specialist 3rd Class) Jaillet.

Blackie Jaillet had been in the Army eight months. His pay had been raised three times and was in immediate prospect of going up another ten bucks. He had gone through three months of intensive schooling with gas engines. Then, just before his twenty-second birthday, he had been made commander-driver of a light tank. Blackie wasn't bellyaching at all.

It was raining the day we met him. It had been raining for several days, and the Louisiana forest was like a steam bath. The primitive back roads, through which the column had moved in yesterday, had been whipped by the trucks and tanks into a mere succession of hog wallows. Later, when Blackie drove us

Meet Private Blackie Jaillet, commander-driver of a light tank after eight months in the Army

Blackie Jaillet, at lower right, above, at the controls of his tank during maneuvers in the damp Louisiana pine woods. At right, he settles down in the pup tent he shares with a comrade of the 66th Armored Regiment

through those roads in his tank—pitching, tossing, spray flying, into the ditch and out

It was just like riding the bow of a sea skiff into a heavy swell. Coming in with a civilian car it was tougher going, passing the streaming trucks and half-tracks, but there was always a jeep to push us out of the grip of General Mud

Except for the crowded roads, the woods seemed almost unpopulated. The 66th was hidden back in the brush, tanks snuggled under the shrubbery, tents in the thick trees Water was dripping from the clothes hanging by the Lieutenant Colonel's pup tent. Everybody was damp. Everybody was itching with chigger bites. Everybody was having a wonderful time.

It was just luck that we got to talking

Directed by a sergeant, Blackie maneuvers his tank among the trees. A tank outfit is no place for a tree lover; maneuvers involve mowing down trees like weeds, unless they are too big

with Blackie Jaillet instead of somebody else. We wanted somebody who was new in the outfit to tell us how he learned to drive a tank. You could tell he was a selectee because he talked in the quick, nervous accents of the eastern industrial worker. Practically all the Regular Army men in the outfit talk with southeastern drawls that you could spread with a butter knife. The division comes from Fort Benning, Ga., and naturally got filled up with local boys. Then, when cadres were split off to form new armored divisions, the ranks were filled in with drafted men from the north.

According to Blackie, it makes a good combination. Practically any buck private in the 2nd Armored Division will tell you he is mighty glad he got assigned to *his* company, because that is the wildest, most reckless bunch of tank riders in the whole lot. In this Blackie Jaillet is no exception. He figures his outfit is good for just about anything.

There is really nothing exceptional about Blackie, unless it is his luck in getting a tank to drive and the speed with which things have happened to him. He is just one of the mechanical-fingered American boys who, during the past year, have been tossed into the Army and told to become tank soldiers. It seems to have worked very much like throwing a batch of ducklings into a puddle.

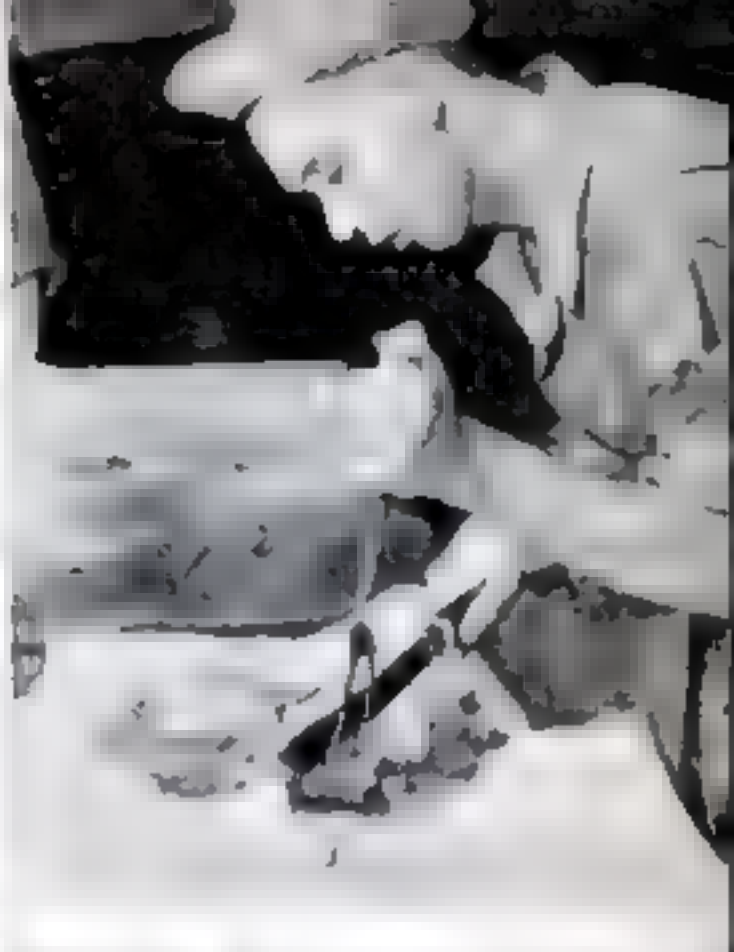
Leandre Joseph Jaillet, as the baptismal records call him, is a little fellow with dark eyes and a quick, lopsided smile. That is, he looks small because his mates are so big, and the compact build inside his coveralls doesn't show his 159 pounds. He came from New Bedford, Mass., where his father had been a deep-sea diver. He went to high school there three years, played football. But last year he was working a lathe in a machine shop at Gardner, Mass.

Blackie was 21 just in time to be caught by the draft, and his number came up early last January. Defense contracts were coming into the shop, and he probably could have made a good plea for deferment. But he decided to take things as they came.

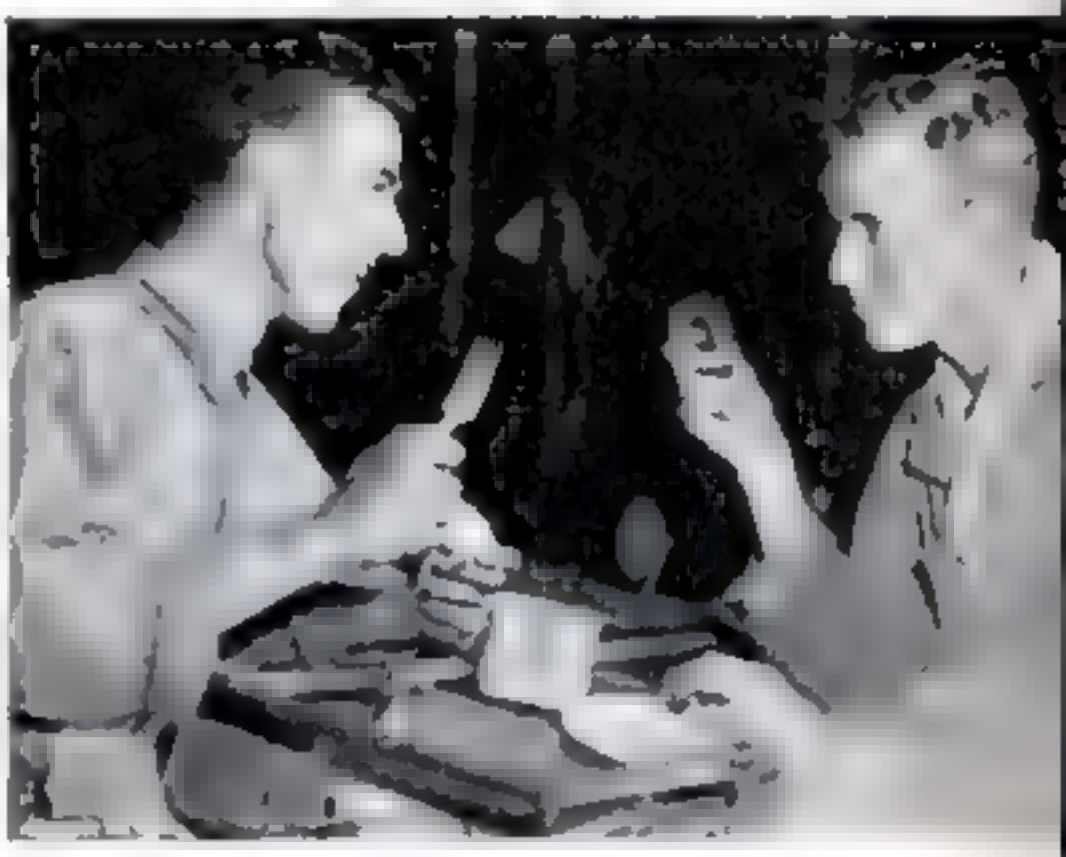
"How'd you like to go down to Benning with the Armored Force?" the Army people asked him when he told them he was a mechanic.

"O. K.," said Blackie. "I gotta spend a

All the comforts of home: a land battleship serves as a dressing table for the morning shave. Chiggers and soggy air lend zest to life in the field



Men must eat, even (or especially) under war conditions. Field kitchens of the Armored Force are organized to serve appetizing and well-balanced meals on the run to these fast-moving, hard-hitting units. Private Jaillet, wielding a fork at right, gets plenty of good food to satisfy an appetite sharpened by jockeying his steel chariot



year anyway." He was philosophic about it.

So he went to Georgia and first put in six weeks at basic training. Practiced close-order drill, how to use a rifle, machine gun, pistol. Though he's been wearing coveralls ever since, he learned how to wrap his leggings. He practiced driving a truck.

Assigned to his outfit, he spent his first day cleaning up a tank which had been working in the mud. That taught him

plenty about the tank, all its cracks, crannies, and crevices.

They took him for a ride and that got him all excited, for he rode standing in the turret, banging on and bumping his ribs while the tank twisted and turned, jumped and careened, clattering and banging with a terrific uproar. The old-timers were giving the kids a workout, drilling in their unofficial motto—reckless driving preferred. That is, it must seem like reckless driving, but a man must know what he is doing. No yellow drivers wanted, said the sergeant. If you were going to jump off a bank, you had to pancake, land bellywhopper, and to do that you had to be going anyway 35 miles an hour.

Blackie was to learn that on his first

Payday is an important feature of Army life. Blackie earned three raises in his first eight months of service. If he's held for a second year, Congress has promised an additional $10

Yankee ingenuity shows itself not only in the handling of internal-combustion engines, but also in providing comforts in the field. Tired muscles relax on this bed made of saplings, boughs, and awning

For letters to parents and the girl back home, writing desks are improvised from packing cases. Men easily adapt themselves to "war" hardships

News reports and sports scores can be picked up on a tank's radio equipment. With the ear-shattering engine stilled, reception sounds unbelievably good

maneuver problem. The corporal driving took the tank off a seven-foot precipice and did it too slow. The tank nosed straight down, and the kid in the turret was pitched out, into the hospital for a long time. They weren't going fast enough, says Blackie, though he never quite figured out what would have happened if they'd tried to pancake off a bank that high. He hasn't been back to try it.

The second day Blackie started driving. An instructor showed him the controls, then took him to a place where a two-acre area had been marked off.

"This place is all yours," he said. "Take it away."

So Blackie drove to his heart's content, learned how the thing handled, practically by himself. Steering was easy, he found out quickly. You have a lever in each hand. Pull back on one, and it stops the track on that side, speeds up the other track. Working them back and forth, right and left, you can twist and turn like a snake.

But that wasn't the half of it. The real art of driving a tank is in shifting the gears. To slow down or stop, you don't step on the brakes; you shift into a lower gear. You

Instead of the traditional songs around the old camp fire, tankers get the latest swing tunes off a radio run by a homemade power plant consisting of a motor-powered generator and storage batteries

have five forward speeds, and you use them all continually. To keep from grinding the gears, the driver must be an expert at double-clutching — going into neutral, engaging the clutch, bringing the engine speed into time with the lower gear, then completing the shift. He's got to do it just as naturally as you'd slip your car from second into high, if he wants to do a smooth job.

Blackie got the hang of it quickly. These light tanks are powered with an airplane-type radial Diesel engine, a nine-cylinder Guiberson and it is important to keep the r. p. m. within a certain range — 1,400 to 2,200 is about the maximum spread, and 1,500 about right. You have a gauge to tell you the revs, but Blackie soon learned to tell them by listening. He learned never to let his engine labor, always to go into a gear at which she can easily handle her 13½-ton load.

This was a lot different from car driving. You couldn't casually step on the gas or the brake. You couldn't lean back and let the tank drive itself. A tank is never under control, and you must keep driving it every minute. Blackie learned to go into a lower gear *before* he came to a ditch or a curve,

Barbering al fresco. Any clump of trees may be transformed into a tonsorial parlor equipped with folding chairs set on platforms or improvised lean-back barber chairs like the one at left in the photo

so that in any maneuver he could keep the engine and tracks pulling. Against all his instincts he learned that he must give her the gun on a curve, so as not to slacken off on track tension and throw a track.

About this time Blackie had been in the Army two months. His base pay continued at $21, for four months, before it went to $30. And now he got a rating as a mechanic, 5th class, which meant $6 extra.

Sergeant Curtis Mitchell, from Eupora, Miss., who rides a tank like a broncho, was putting Blackie through the jumps. Blackie needed his big helmet, like oversized football headgear, as the iron horse bucked and careened.

"Monkey see, monkey do," said the sergeant. "Drive her this way. That's the way to learn."

You can't relax when you're driving a tank, and there's no taking it easy in the training for it, either.

Within a week Blackie was driving in a convoy, straining every nerve to keep at the proper 50 yards distance from the tank in front of him. The sergeant taught him to watch for a burst of exhaust smoke from the tank ahead. That meant the driver was speeding up his engine in order to shift gears and slow down. So Blackie had to shift quick too.

Blackie learned to drive by nose and by ear. Moving in convoy by night, blacked out, your little blue lights show you only about ten feet of the road ahead. But you've got to keep that 50-yard space, for safety from bombing. Blackie learned quickly to slow down when he smelled a fresh blast of exhaust smoke from his leading tank. But the ear business was harder. Amid all the clatter and banging of the tank, like a moving boiler factory, he gradually learned to pick out the humming sound of the muffler ahead. When that humming increased it meant to speed up, the tank ahead was going faster.

A tank outfit is no place for a tree lover. Blackie learned to drive in the woods, mowing down the pines like weeds, apparently with reckless abandon, actually with tense care—twisting and dodging among the trees where feasible, or banging square into them and pushing them over. You mustn't bang your tracks into a tree, but pick your tree and take it full between the tracks. A light tank pushes over an eight-inch pine tree easily, but a smaller oak or hickory will give it a jolt.

Blackie learned to duck around a tree that was leaning toward him. It might fall toward the tank, instead of away, and kill the man in the turret. He learned to be careful about back-tracking—that is, driving back in the opposite direction over a woods route where tanks have come. First, the ground may be all mushed up and bog you down. Second, there will be a sapling pushed over, which has sprung back up just enough to crash in through the openings of the tank like a shattering spear. Back-tracking through the woods you always have to button up—close up your armor plate and drive blind.

Driving in a blackout is like blindman's buff, but driving buttoned up is worse. There is only a tiny slit to see through, and the driver can only give perfect obedience to the man standing in the turret. Foot on the right shoulder, turn right; foot on the left shoulder, turn left; kicks in the back for other things. Teamwork and implicit trust is what this takes.

Blackie was just getting good when they raised his pay again—to 4th Class Specialist, $45 a month—and sent him to Fort Knox for three months. There he studied gas engines intensively, not just tank engines, but truck and car engines—stuff that will be useful all his life.

He got back to his outfit in July, feeling pretty cocky, and was put on K.P. duty for a week. Everybody in the 66th does his trick at K.P. And when Blackie got another advancement, to 3rd Class Specialist, $50 a month, he didn't feel at all bad about it.

Soon after this Blackie got his full permit as a tank driver. (Army drivers have permits, like civilian licenses, qualifying them for driving different kinds of vehicles.) And incredibly soon thereafter, he found himself put in complete charge of a tank. Ordinarily a noncommissioned officer commands a tank, but with so many being moved to other outfits, or going to school, nowadays frequently a private gets the chance.

There was only one trouble. None of his three-man crew was yet fully qualified to drive in maneuvers, so Blackie had to do the driving himself and put one of his men in the turret. But that was only for a short time. Blackie was monkey-see-monkey-doing them at a great rate. Soon he would ride in the turret of his own tank, just like the general.

That's Blackie's story. Nothing especially startling about it. But multiply it a few thousand times, and then you have something. Blackie's glad he went in the Army. He thinks it's treated him fine.

He's hoping he won't get that $10 raise Congress has promised for the second year in the service. He has a girl back home. He calls her up every payday, but that is not so good as being there. At the end of his year he'd like to go home to his job.

But of course, if Uncle Sam really needs him longer, that will be O. K. by Blackie.—HICKMAN POWELL.

Radiant Heat Cuts Fuel Costs

Exterior and interior views of a five-room radiant-heated house near Pittsburgh, Pa. The living room, above, has no radiators, heat coming from water pipes in the floor. At left, basement with gas-fired boiler and expansion tank

This is how the new heating method works. By warming the floors, walls, and furniture while leaving the air in the room relatively cool, it provides comfort for occupants without that stuffy feeling

SUMMER air-conditioning now has a winter counterpart, radiant heating. This new heating method already is making hundreds of American homes, offices, schools, and churches more comfortable in cold weather, and, according to its engineers, uses from 30 to 35 percent less fuel than conventional systems.

Everyone has seen movies of pretty girls in bathing suits frolicking outdoors in the snow. Even though the temperature is freezing, they are not uncomfortable. The reason is that radiant heat rays, coming directly from the sun and by reflection from the snow, strike their bodies. This balances the heat lost to the cold air. Radiant heating for buildings is based on the same principle.

No conventional radiators or hot-air vents

Installation of water-pipe coils in the construction of a two-story home at Muscatine, Iowa. At the left, coils for the floor of the first story are laid on gravel; at right, installation of coils for the second floor. The pipes are laid and covered in such a way that heat will not crack plaster or warp wood

are used. Instead, coils of pipes are built into an entire floor, wall, or ceiling. Hot water, or sometimes hot air, circulates through the pipes. Heat rays are radiated and reflected to every part of the room.

Radiant heating makes two obvious contributions to comfort. It does away with the maddening ordeal of stepping out of bed onto a cold floor. It also eliminates the drafty air currents set up by ordinary radiators. But radiant heating also promotes comfort in a more important way. It was "tuned" to the human body by engineers who first studied the physiology of heating.

The body produces more heat than it needs. It must get rid of this extra heat to be comfortable. You feel hot when the body has difficulty giving up its excess heat, cold when it loses heat too fast.

Most of the body's excess heat is carried away by two methods, by convection to the air and by radiation to cooler objects. Conventional heating systems, which warm only the air, cause the body to lose little heat by convection, more by radiation to cold walls and floors. Radiant heating, which warms walls and floors without overheating the air, causes the body to lose less of its heat by radiation than by convection.

Physiological tests show that maximum comfort in winter lies in preventing too much loss of heat by the body through radiation. Radiant heating accomplishes this.

Fuel is saved by the very fact that the air in the house need not be kept so warm. Another advantage is that the heating equipment is out of sight and takes no space.

Radiant heating systems take careful planning. The size and architecture of rooms must be studied before the coil system is designed. Coils must be installed so they will not crack plaster or warp wood when hot. But radiant heating, like proper insulation, will repay the cost of installation in a few years by fuel savings. The added comfort is your dividend.

For the office building of the Greenville Steel & Foundry Co. plant at Greenville, S. C., hot-water pipes were laid on a foundation of broken stone fill, as shows at left, below. Then additional stone was placed around the pipes and a concrete slab about two inches thick was poured to form the floor

Things to do with Soap ... BESIDES WASHING

FROM creating realistic artificial snow for your Christmas tree to detecting gas leaks, from stopping runs in silk stockings to lubricating stubborn windows and bureau drawers, ordinary household soap may be put to dozens of uses besides the fundamental one of washing with it. Illustrated on this and the two following pages are 12 ways in which soap can be helpful in the home and in the shop. In addition, it becomes a medium of self-expression in soap sculpture, now a recognized art form; housewives soak broom bristles in soapsuds to stiffen them; soap applied to mosquito bites stops itching, and soapsuds are an antidote for poisoning by acids.

CASTINGS WILL NOT STICK to rubber or plaster molds which have been lubricated with soap. All you need to do is to brush strong soapy water or liquid soap over the inside of the mold before casting.

RETOUCHING PHOTOGRAPHS is simplified by mixing a little soap in the water used for moistening the spotting colors. It makes the colors spread more easily on a glossy or oily surface.

GREASING SCREWS, by rubbing them on a piece of soap as shown below, makes it easier to drive them into hard wood. Nails take less pounding, too, when given this treatment. Soaping not only saves work, but also lessens the danger of splitting.

AS A PINCUSHION, a bar of soap makes a handy place to stick needles and pins. What's more, it lubricates them so they will go through stiff fabrics with less effort. In sewing, an occasional jab of the needle into soap helps.

(Continued)

SOAP IS GOOD STUFF TO HAVE ON HAND

HOW MUCH SOFTENER does your tap water need? To a measured amount of distilled water add a strong solution of soap in denatured alcohol until an even layer of suds is formed when the bottle is shaken as shown. Now see how much softener must be added to your tap water to give the same result with the same number of drops of the solution.

ARTIFICIAL SNOW for your Christmas tree can be made by beating up a thick suds of soap powder or flakes with an egg beater and applying it to the branches with a spatula or a cake icer. To give it more sparkle, some of the mica flakes sold as artificial snow may be mixed with the suds, or sprinkled on the branches while the foam is still wet.

BEFORE TACKLING A DIRTY JOB, rub wet soap into your hands and scratch some under your finger nails. Let it dry there. When your work is done, the grime will wash off much more easily than it would if you had not used this trick—and your nails will be perfectly clean!

RUNS IN SILK STOCKINGS can be stopped temporarily with soap. Just moisten the corner of a cake of soap and rub it on the top of the run. This treatment will keep the run from spreading until there is an opportunity to change stockings and make permanent repairs.

. . . AND WE DON'T MEAN IN THE WASHBOWL

LEAKS IN GAS-PIPE JOINTS are located easily and safely by painting around the suspected joint with soapsuds. Gas bubbling through the suds shows the leak. This method has a great advantage over the all-too-common one of testing for leaks with a lighted match, in that there is no danger of an explosion.

STICKING DRAWERS slide easily after their runners have been rubbed with a moistened cake of soap. The same treatment is effective for doors that stick, the soap being rubbed on the places that scrape. For loosening stubborn windows, rub soap in the jambs and stop strips—if you can move the window enough to get at them.

SUCTION CUPS STICK BETTER and stay put longer on walls, if their edges are rubbed on a wet piece of soap or a soapy cloth before they are applied. The cup also has less tendency to leave an indelible ring on the wall when it is removed. This trick works equally well on glass, porcelain, or tile.

PATTERNS FOR CASTING small metal parts for ship and other models can be carved of soap. Having no grain, it is much easier to carve into small objects than soft wood, the material commonly used for this purpose. Because of its greasy nature, it will not stick to a plaster mold.

Book Review

YOUR OWN FURNITURE. Calling for a kit of only 17 hand tools, and no knowledge of woodworking, "How to Make Your Own Furniture" (Harper & Brothers) shows how to start furnishing your home with your own handiwork. The author, Eugene O'Hare, begins with simple modern bookcase, then, with detailed plans, drawings, and description, goes on to other pieces, including a couch end, a desk and bench, a hinged-top drawer, a magazine rack, a coffee table, and a dressing table. From there the tyro woodworker, with his newly acquired skill, can take up more complicated furniture.

REPAIRS AT HOME. A cook book is one essential to the lady of the house, and "Keeping Your House in Repair" (Harper & Brothers) is just as important to the man. A. Frederick Collins, in his preface, reports that a dispute with a plumber started him off as his own successful repair man. Carpentry came next, then he went down the whole list of repair jobs—roof, masonry and plastering, stucco and concrete, painting and paperhanging, glazing, heating, and electricity. When to do what and how is discussed fully and illustrated, lists of tools and how to use them are given, and it is all in nontechnical language which the average householder can understand and follow.

CHEMISTRY FOR STUDENTS. A new edition, the first since 1933, of Stuart R. Brinkley's "Principles of General Chemistry" (The Macmillan Company) presents a revised approach for the student. The order of the topics has been modified with a view to providing a sounder basis for his scientific reasoning. Although the book places emphasis on the principles of the science, the industrial applications and processes are included to indicate the importance of chemistry in the modern world.

Question Bee

To test your knowledge of patent law, try to pick out the true statements below. Answers on page 220

1 Patent law requires that *(a)* no person may hold more than 50 patents *(b)* a patent application for an improved machine must clearly distinguish between what is new and what is old *(c)* any U.S. inventor must also apply for a patent in Great Britain.

2 "Patent applied for," imprinted on a manufactured article, *(a)* prevents other people from making it lawfully *(b)* has no effect whatever in law.

3 The life of a patent for a mechanical device is *(a)* one year *(b)* 17 years *(c)* perpetuity.

4 A patent is *(a)* conclusive proof that an invention belongs to you *(b)* of practically no use at all *(c)* evidence that may be successfully contested by an earlier inventor.

5 To protect your rights to a new flowering plant, you would apply for a *(a)* trade-mark *(b)* patent *(c)* copyright.

6 If an employee is going to turn over his invention to his company, the patent application should be in the name of the *(a)* employee *(b)* president of the company *(c)* patent lawyer.

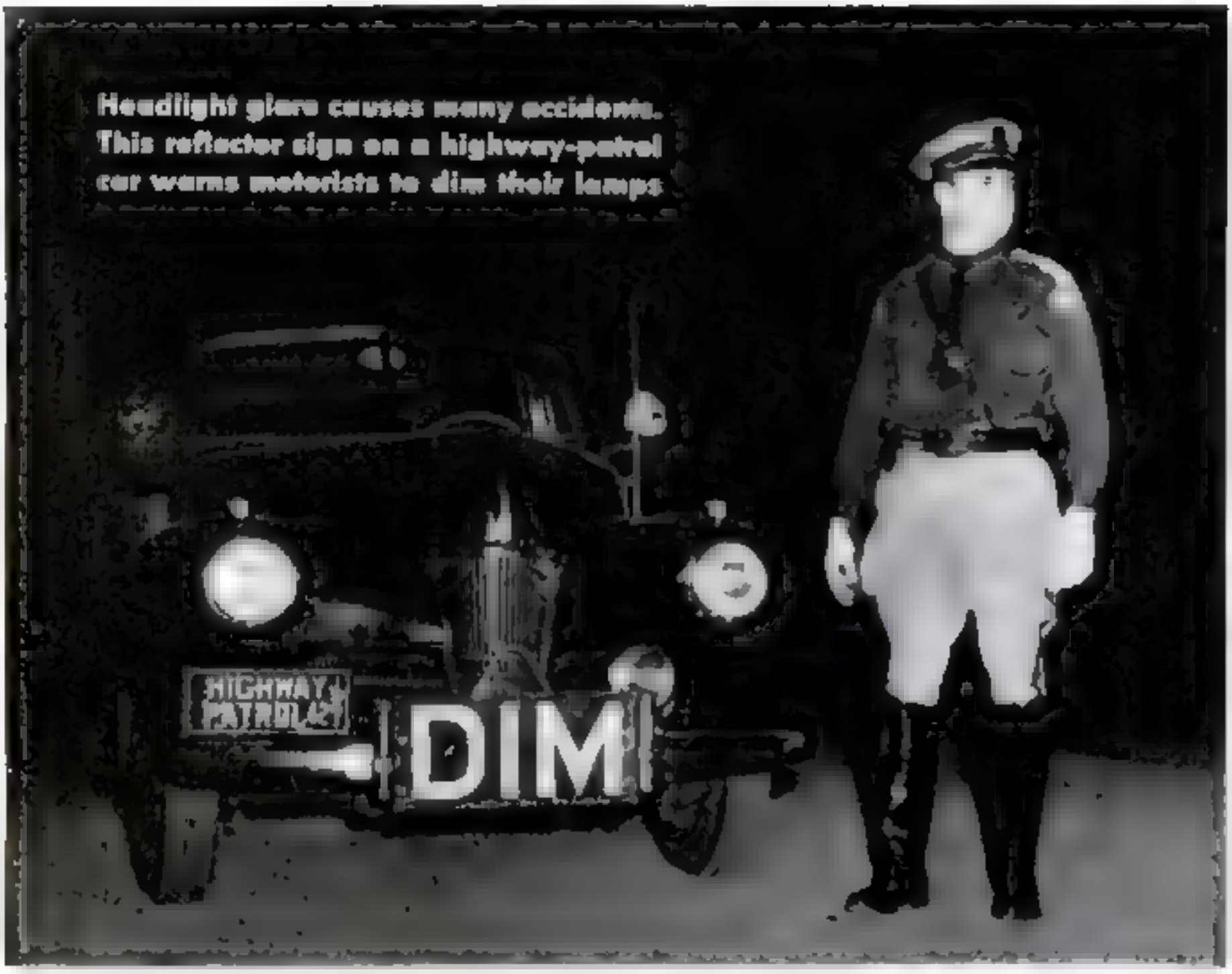
7 An "interference" means that *(a)* a patent is openly being infringed upon *(b)* two or more independent parties claim the same invention *(c)* moving parts of a full-size machine would obstruct each other.

8 When a patent expires, *(a)* the holder can renew it if no one else objects *(b)* the Government sells it at auction *(c)* it automatically becomes public property.

AUTOS

Common-Sense Safety Rules for Driving at Night

(NEXT PAGE)



Mile for Mile, Your Chances of a Bad Accident Are Three Times as Great After Dark as by Day

By MYRON M. STEARNS

NEARLY two thirds of all fatal traffic accidents on American highways occur at night. The exact percentage is 64.9. While about 15,000 people will be killed this year in daylight traffic accidents, 22,000 will be killed at night. This is in spite of the fact that there is far less travel at night than during the daytime.

Your chances of being killed at night, for each mile you travel, are *three times as great* as during the day.

The danger of night accidents is getting greater each year. Since 1930 traffic deaths at night have increased more than 15 percent, although daylight accidents have been cut down.

The greatest night hazards of all are on open highways in the country. During the past ten years, fatal accidents on rural highways have increased *52 percent*.

Safety experts say the appalling number of fatal night accidents results from low visibility. That simply means you can't see well in the dark. Plenty of examples of how good lighting cuts down night accidents in cities are already on the record. Sodium-vapor lighting, for example, was installed at three dangerous intersections in Chicago. The year following the installation showed a 58-percent reduction in night accidents at those points. Ten miles of streets in Hartford, Conn., were given improved lighting; they showed a decrease of 46 percent in night accidents, while on streets where the lighting was not improved night accidents increased 4.1 percent during the same period.

A more understandable reason for night accidents is fast driving—or failing, that is, to slow down sufficiently for the increased danger that comes with low visibility.

Four motorists out of five "overdrive" their headlights at least a part of the time. They drive at a speed that makes it impossible to stop within the distance that their headlights show is clear in front of them.

Obviously, unremitting care of headlights is necessary for safe night driving. Even the dust that ordinarily collects on a lens

Marking of highway center stripes with a light-reflecting paint is a new step toward making the roads safer at night. The photograph above shows such a marking . . .

. . . and this is how it looks from behind a steering wheel. In the glare of the headlights, the line stands out brightly

Reflecting guides set at the side of a road show how the pavement curves. Low visibility is the chief cause of night accidents. Four out of five motorists "overdrive" their headlights part of the time —cannot stop within the range of the light

Ten Safety Rules for Night Driving

1. Drive "within your headlights," so you can stop within the distance you can see ahead.
2. Always depress your headlights for approaching cars.
3. Keep your windshield and headlight lenses clean.
4. Don't drive even a short distance at night when you are very tired.
5. Watch continuously for pedestrians and other unlighted objects on the road.
6. Don't stop on the highway at night. If you must, keep parking lights and dome light on.
7. In meeting cars, give them all the room you can.
8. Remember that drinking adds greatly to the dangers of night driving.
9. Have your eyesight checked from time to time and get glasses as needed.
10. Keep a window open for better air circulation and hearing.

every 24 hours makes a difference in the light that is thrown ahead of your car. If you don't believe it, go to any good headlight-testing station after your lenses haven't been touched for a couple of days, and have them test the light for you, before and after a single cleansing swipe.

Here is a table for stopping distances, at only 30 miles an hour, that explains still further the safe driving speeds given in an accompanying table:

	Stopping distance
Conditions ideal, everything O.K.	95 ft.
Add 5% down grade	101 "
Add wet pavement	183 "
Add smooth tires	248 "
Add fatigue	281 "

Proper use of headlights is just as important in avoiding night accidents as proper care of them. Again and again accident victims explain they were blinded by the glare of approaching headlights that were not properly dimmed or depressed. The new sealed-beam headlights, which give better light than anything that has preceded them, throw a stronger light into the eyes of an approaching driver when improperly used.

Safe Driving Speeds

"Safe" speed for an alert driver, in a good car on a good road, with good brakes and good headlights that show the road ahead for at least 227 feet — 50 m.p.h.

Same, but with a five-percent down grade — 48 m.p.h.

Add rain, increasing the braking distance — 34 m.p.h.

Add worn tires, increasing the danger of a skid — 28 m.p.h.

Add fatigue, so that the driver's reaction time before applying brakes is lengthened from the average of .75 to 1.5 seconds — 27 m.p.h.

Add poor headlights, reducing visibility from 227 to 175 feet — 23 m.p.h.

Add approaching headlights, with glare reducing visibility to 100 feet — 16 m.p.h.

The accepted distance for depressing headlights when approaching another car is 1,000 feet, or about a fifth of a mile. A fact not generally understood by most motorists is that depressing headlights contributes to your own safety *whether or not* the other driver also depresses his lights.

"Silhouette lighting" gives a definite advantage if your headlights are properly depressed. That is, objects between approaching cars can be seen in silhouette against the background of the road surface, illumined by the lights of the approaching car, if your own lights are thrown down.

To take full advantage of "silhouette lighting," however, a driver has to give his whole attention to the road. A glance at the speedometer or instrument panel when another car is approaching you, or looking too directly at his lights, can easily divert attention long enough to cause you to miss a silhouette as the approaching car passes it.

Another little-known fact is that older drivers are much more susceptible to glare than younger drivers. The average man of 60 can withstand only one fifth as much glare as a man of 20.

The majority of night-accident victims are pedestrians. Half of all pedestrian deaths for the whole year occur between 6 p.m. and midnight. In cities over 100,000 during the past two years seven out of ten pedestrians killed were struck at night. In Connecticut 89 percent of all adult pedestrians killed in traffic accidents were struck at night.

Nine out of ten pedestrians who are struck by automobiles at night—19 out of 20 in some states—*are not motorists themselves.* Consequently they do not realize, while they are standing in the bright glare from approaching headlights, that they themselves may be unseen. Frequently they wear dark clothes that make them invisible until just before they are hit. Sometimes the light stockings that women wear give the only warning an approaching driver receives.

Fatigue plays an important part in many night accidents. Seventy-three percent of driver-asleep accidents in New Jersey over a three-year period occurred between 6 p.m. and 6 a.m. Twelve hundred longhaul truck drivers, examined in Baltimore, Nashville, and Chicago, proved to be definitely less efficient in reaction-time, driving vigilance, manual steadiness, and in speed and accuracy of eye movements, after ten hours or more of driving. After a long drive you can't judge distances as accurately, steer as steadily, stop as quickly, or see nearly as far ahead, as when you are rested.

Alcohol also figures unduly in night accidents. Both pedestrians and drivers who have been drinking are five times as nu-

merous in fatal night accidents as in daytime accidents. In one Connecticut study, 14 "pedestrians" out of 100 who were struck in night traffic accidents were lying on the roadway or at the edge of it.

After the day's work the evening, for many people, is a sort of vacation. The resultant feeling of release from restraint, combined with alcohol, causes many traffic deaths. This shows up in the night-accident record during the week. On Monday and Tuesday nights, accidents result in 55 percent of the traffic fatals; on Wednesday and Thursday they contribute 56 percent of the total. On Friday, it is 62 percent, on Saturday 63 and on Sunday 70 percent. More than one quarter of all the fatal traffic accident victims during the entire year are killed on Saturday and Sunday nights, when people are "let down."

WRONG

This pedestrian is taking a chance two ways: He is walking on the wrong side of an unlit rural highway in dark clothing. All that the approaching driver can see of him is his neck, hands, and white socks

RIGHT

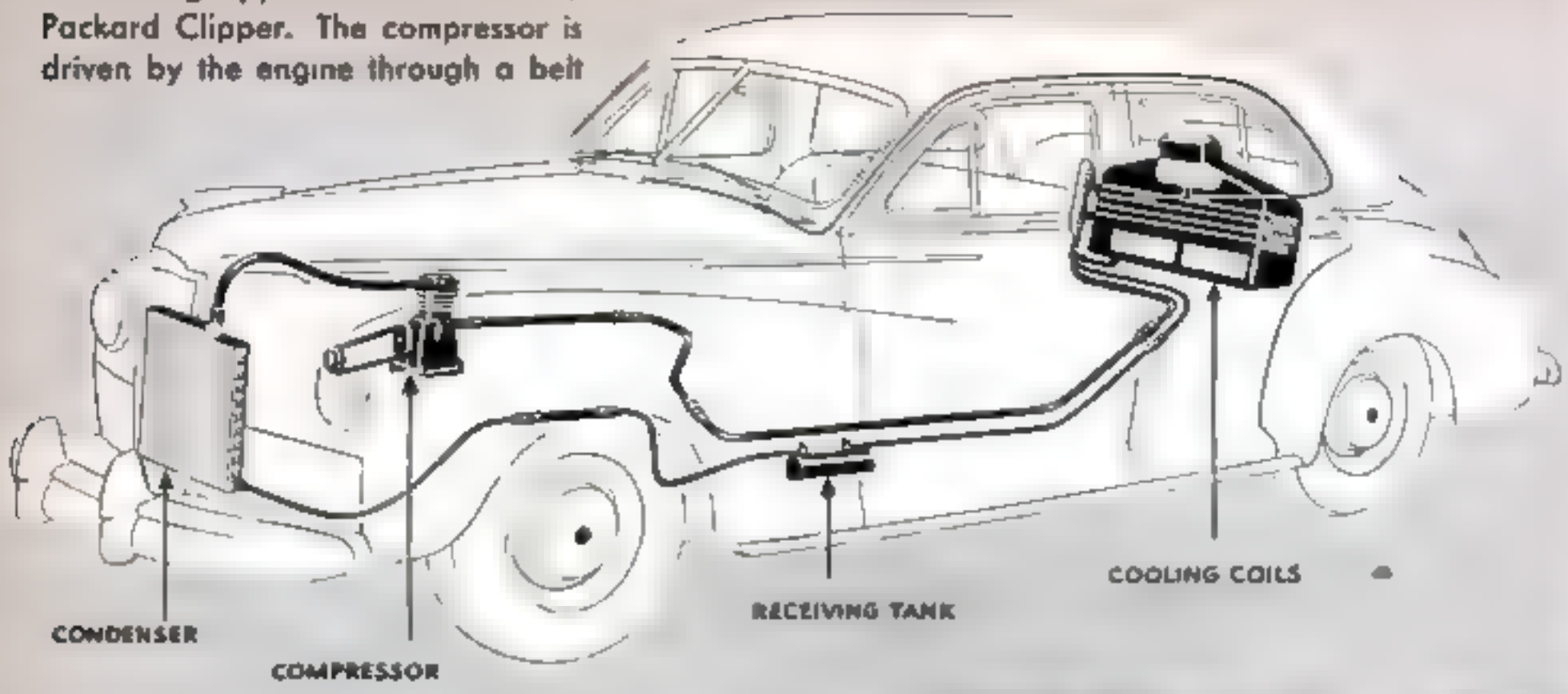
This man is using common sense. He walks on the left side, facing traffic. His face and shirt bosom catch the light and, as an added precaution, he is carrying a white handkerchief in his right hand

Bad driving practices become still more dangerous at night. Following another car too closely, which is one of the worst faults of most drivers today, is deadly in the dark The speed of the car ahead cannot be judged as accurately as in the daytime; a sudden slow-down cannot be noted as quickly. Hogging the middle of the road is far worse at night than in the daytime. The danger of sideswiping, or of being sideswiped, is immeasurably increased when the other driver is blinded by glare or cannot accurately see the side of your car.

Overtaking and passing another car improperly is also infinitely more dangerous at night than in the daytime: the speed of an oncoming car cannot be judged as accurately at night, while some suddenly seen hazard may cause the car being overtaken to swing abruptly into the course of the overtaking car.

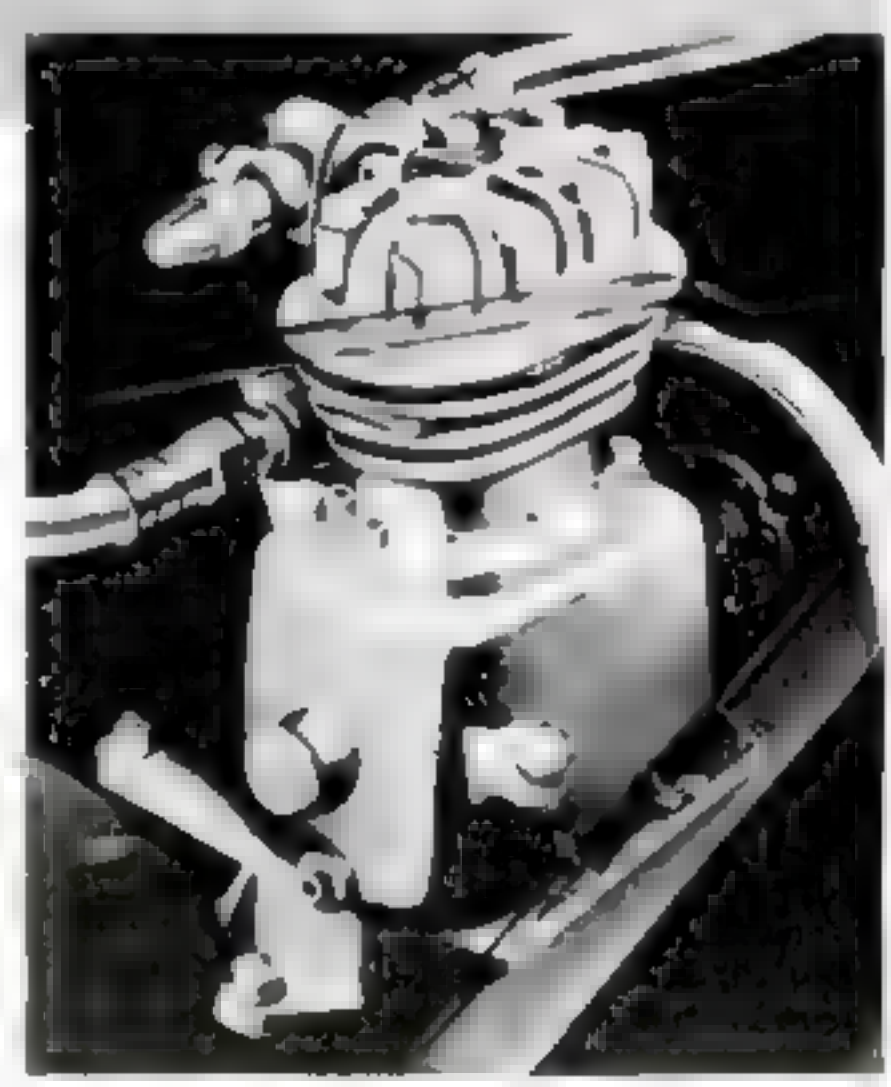
Both the National Safety Council and the American Automobile Association are working to lessen the dangers of night driving, but improvement is chiefly dependent on individual pedestrians and drivers.

Air-cooling apparatus installed in a Packard Clipper. The compressor is driven by the engine through a belt



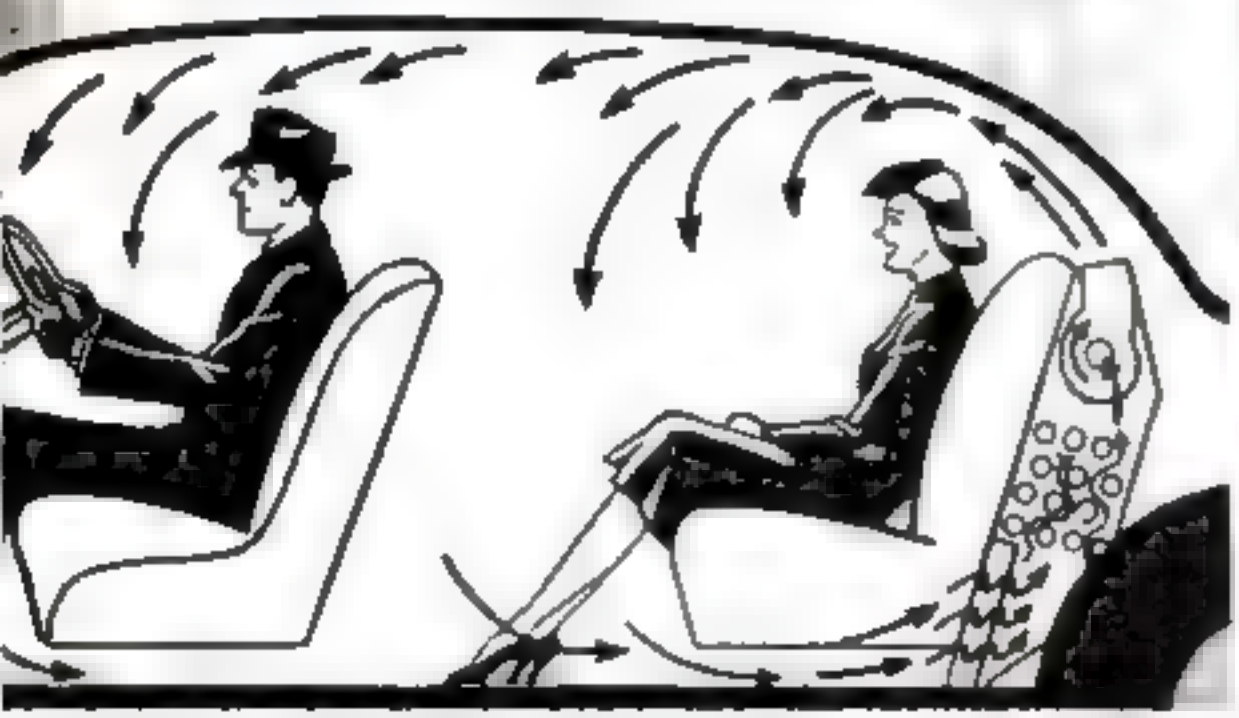
Air Conditioner Assures Year-Round Car Comfort

CONTROLLED from the dashboard and operating on the same principle as electric refrigerators, an improved air-conditioning system is now offered as extra equipment on Packard closed cars. The cooling effectiveness at 60 miles an hour is said to be the equivalent of melting two tons of ice in a 24-hour period. An odorless and nontoxic gas is used as the refrigerant. Compressed by a pump driven by the car motor, the gas flows to a condenser behind the radiator grille where it is cooled. Cooling converts the compressed gas to a liquid which flows into a receiver or storage tank from which it is slowly valved into coils behind the rear seat. The released pressure turns the refrigerant back to gas that is icy cold. Air cleaned and dehumidified by filters is blown over the chilled coils and circulated through the car.



Close-up of the pump mounted on the engine to compress and circulate the gas refrigerant. Below, coil unit behind rear seat carries the defroster, filter, blower, and dehumidifier

How the cooled, filtered, and dehumidified air, drawn over the cooling unit by an electric blower, is circulated through the car body and then returned for re-use



Trucks and Trailers

GET STILL MORE ARMY JOBS

How the Quartermaster Corps Solves the Problem of Keeping Men and Machines on the March

By SCHUYLER VAN DUYNE

AMERICA'S fast-traveling motorized Army doesn't have to wait for the supply and maintenance forces that keep it rolling. They are close on its heels, or tailboards, with their own front bumpers. And they bring up the dusty rear with a wide variety of truck and trailer-mounted necessities and comforts.

Probably no other army in the world can boast of the rolling service vehicles that America has developed in recent months. Tailor shops, shoe-repair shops, bakeries, a church, even complete bathing units, nowadays roll along behind truck-borne and mechanized troops that speed across country at a rate that amazes soldiers of the first World War.

Credit for the development of much of the equipment goes to the Quartermaster Corps, which takes it in strides that appear to be unlimited. Credit for the quantity production of the specialized units goes to the car and truck manufacturers, and the cooperating accessory and parts makers. And this automotive accessory group now includes the makers of such items as sewing machines, shoe-repair devices, surgical instruments, plumbing fixtures, and soda-pop dispensers.

Instigators of the whole development, of course, are the motorized military branches that require the specialized services of permanent encampments even while they travel far from their bases. For an army moves on its feet no small part of the time. That means, even to motorized troops, that shoe leather is going to wear out.

That's why at Camp Lee, in Virginia, you will find a mobile shoe-repair shop that can chase after the Army and keep up with its fastest maneuvers. This shop recently demonstrated its ability in the hands of skilled workers to repair 200 pairs of shoes a day, miles from camp! It includes all the latest power machinery of your city shop, such as sewing machines, buffing wheels, and the like. Housed in a trailer which is towed by a truck carrying a gasoline-electric genera-

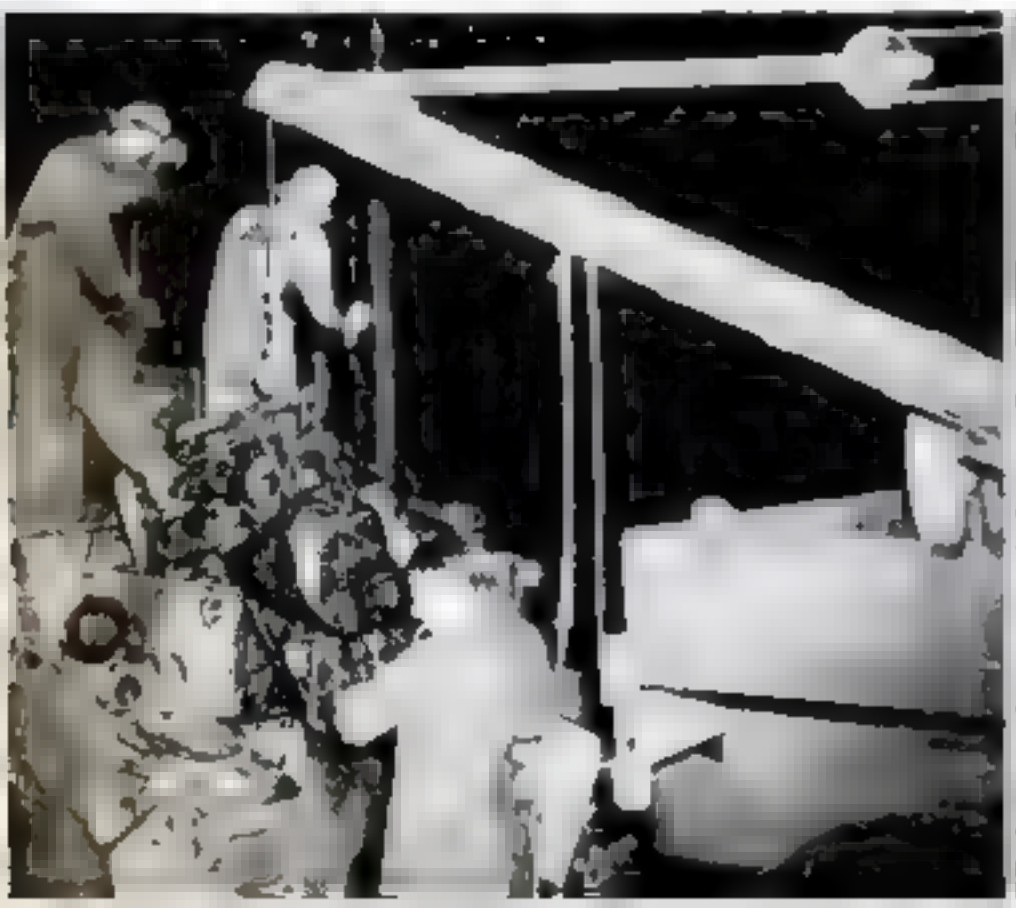
Soldiers wear out shoes, too. So this shoe shop on wheels was designed to follow motorized troops wherever they go. Power machinery (below) equal to the best in modern city shops is installed in the truck-hauled trailer at the right

On maneuvers, today's soldiers can even get baths. The mobile bathing unit above provides ample hot water and soap. The truck-drawn trailer also steam-sterilizes clothes and carries dressing-tent shelters

tor plant, the unit can be parked anywhere that other vehicles can lead it and set up shop for business in a matter of minutes. It went through the entire September war games in Louisiana without a mishap, winning praise for its designers.

One serious problem of an army on the go is keeping clean. New mobile units not only provide hot showers for 50 soldiers an hour, but wash, sterilize, and dry their clothes, see them through a physical exam, and supply new clothes if old ones are worn out. The unit consists of a truck-powered trailer and four tents. A boiler in the trailer supplies hot water for the men and steam for their clothes. The four tents are set up near the trailer and used for undressing, physical examinations, salvaging worn garments or providing new ones, and dressing. Eleven men can shower at once in the stall-equipped trailer. A rigid time schedule for a hot dousing, soaping, hot and cold rinsing, and toweling, preclude loitering by its users, and seriously curtail that popular pastime

Mechanized and motorized troops mean maintenance. Below at left, a huge wrecking-truck crane is lifting a tank engine from its mounting for repairs at the front. Right, one of the machine-shop trucks that must follow the mechanized troops to keep them moving. Note bins for spare parts under the workbench



of singing in the shower. But the soldiers like it anyhow.

Less of the body and spirit than shower baths, but vital to the machine-age soldier nonetheless, are the mobile maintenance units that carry tools and replacement materials for 90 to 95 per cent of the shop work required of an armored division's small weapons and mechanized equipment. These units range in size all the way from solo motorcycles whose mechanic-riders can rush small parts to disabled vehicles and replace them on the spot, to 36,000-pound wrecking trucks that can right an upset tank or whip out its engine for a major overhaul or replacement. Both the Quartermaster Corps and the Ordnance Maintenance units man such vehicles, the Quartermaster Corps usually concentrating on motor vehicles, while the Ordnance personnel adds to automotive, truck, and tank maintenance the repair and maintenance of small arms and fire-control instruments.

For their varied tasks, the vehicles are model modern machine shops, and no small part of their tonnage burden is a vast supply of spare parts, battery chargers, field glasses, tires, car armament, rifles, automatic pistols, gun sights, and other impedimenta of mechanized war makers. Any such items can be repaired or replaced virtually on the firing line by the highly trained personnel manning the supply-repair vehicles and the power-driven machine tools they haul.

Again, on the lighter side, soldiers on maneuvers far from village stores or city shops can now buy such items as tooth paste, razor blades, cigarettes, and soda pop at a mobile sales commissary recently built to follow them into the field. Carried on a 2½-ton truck, the commissary can handle the needs of 8,000 men with a personnel of but four men and a driver.

Most of the special motorized units the current military preparedness is fathering had their cumbersome, usually stationary ancestral counterparts during World War I. But added to their static functions, many of today's units must work or prepare to work while still in transit—rapid transit, at that. Thus, aboard the Army's new mobile-laundry units now being tested, the boilers and hot-water heaters are put in operation while their carriers are still moving, so that laundering can start immediately upon arrival at a destination.

A complete mobile laundry, manned by a company of 153 soldiers and five officers, consists of ten four-wheel semitrailers. Each trailer holds a washing machine, an extractor, and two steam-heated tumblers for drying. A motor-generator powers the machinery, an oil-burning boiler provides steam for the tumblers, and a heater readies the washing water. Each trailer also carries 50 gallons of fuel. One company of men and trailers can handle the laundry of 15,000 soldiers a week.

As a feature of its well-developed motorized Medical Corps (P.S.M. Aug. '41, p. 108), the Army is just completing many months of tests on mobile surgical-hospital units which carry the major equipment of the finest hospitals right up behind the firing line to make possible emergency surgery for men too critically wounded to be sent back to base hospitals.

The hospital units have fourteen vehicles each, seven comprising the operating group with four operating rooms, a sterilizing room, an X-ray room, and a medical-supply room and office. Light, heat, ventilation, water supply, sterilizer, electric power, and

Far from city stores, a soldier may still need cigarettes. The well-supplied commissary truck at right goes with the Army to dispense smokes and soft drinks during rest periods on a motorized march. With five men, it serves the needs of 8,000 soldier customers

Above, a type of trailer-mounted mobile laundry which washes, dries, sorts and bundles a soldier's clothes quickly on maneuvers. Right, clean clothes coming from a tumbler-type drier

all other equipment and needs are provided by the self-contained truck units. In use, the operating-room, sterilizer, and X-ray vehicles are backed into a central tent. Patients are housed in ward tents erected near-by

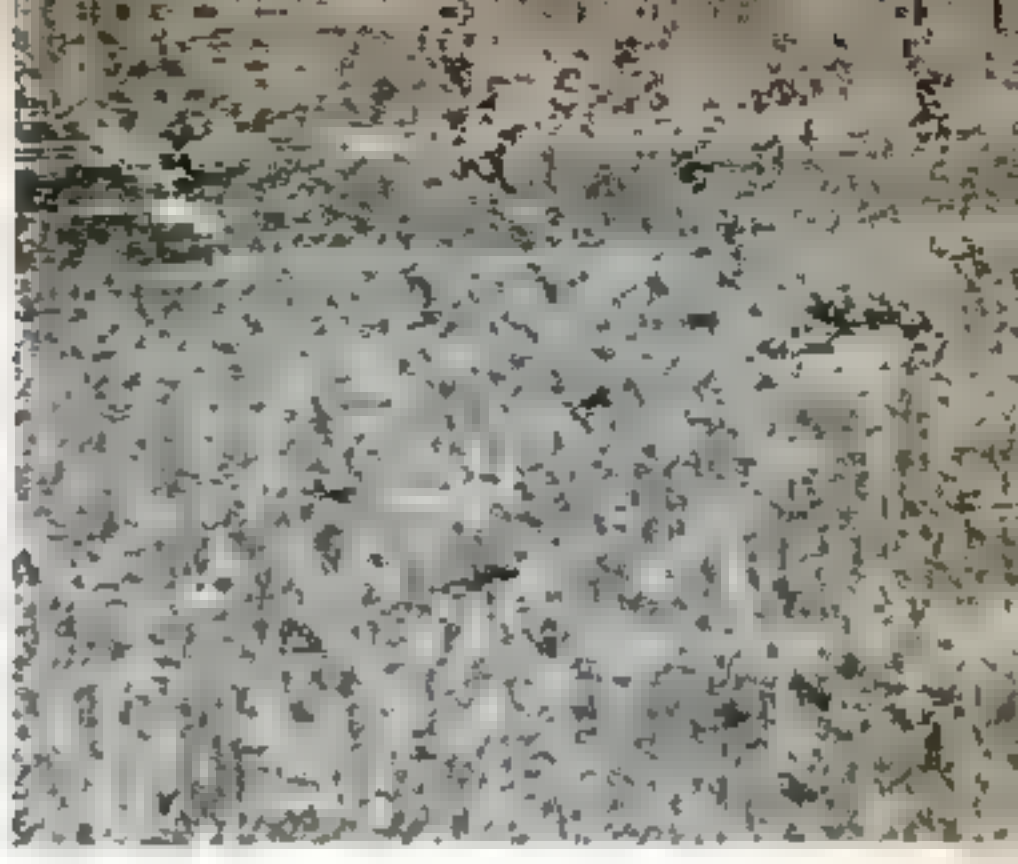
One of the latest developments of the Quartermaster Corps is a rolling tailor shop that provides soldiers in the field with additional services heretofore available only at their home posts. Mounted on two truck trailers, one section repairs clothing of all types from shirts to shorts, the other handles heavier materials like blankets, webbing, and tent fabrics. With its own generator for light and power, the mobile repair department includes six sewing machines, a button machine, and a cylinder darner in one section, and four sewers, an overedging machine, and a flat darner in the other.

An enterprising Army chaplain who made his way about in a station wagon, which he didn't mind, and conducted services in makeshift quarters, which he did mind, has designed a traveling chapel that may become a pattern for many more just like it. Built by his own regimental repair shop, its foundation is a salvaged truck chassis. Its well-constructed walls and roof house a movable altar, as well as shelves for a circulating library of 300 books. A one-piece rear panel forms a sort of oversize tailboard which opens on hinges and rests on removable posts to form a platform.

Equally ingenious is the Army's new mobile bakery that not only turns out 4,000 loaves of bread a day, but does it "on the march." The 19-ton outfit consists of a tractor truck, a semitrailer, and a specially designed long trailer behind that, all running on 22 wheels. Within are a mixer that kneads 150 pounds of dough at a wallop, a huge dough trough, a 250-gallon water tank, an automatic molder, pans, a dough raising compartment, and a revolving oven.

"Service to the Line," is the Quartermaster Corps slogan. And if it means mounting the "service" on 60-mile-an-hour vehicles, it's still all right with the quartermasters. They'll have it there when needed!

Wear is hard to see on piston run with new-type oil



This piston was lubricated with ordinary oil

"Fortified" Engine Oil Kills 3 Motor Bogeys

INTENDED to retire the three bogeys of engine operation—sludge and varnish formation, oil-ring clogging, and wear—a "thermocharged" lubricating oil containing a blend of six secret chemicals has been perfected by engineers for the Standard Oil Company of California. As one test to demonstrate how bearing surfaces remain remarkably clean, an engine lubricated with the treated oil in one cylinder and an ordinary oil in another was operated at 62 miles an hour for 6,600 miles.

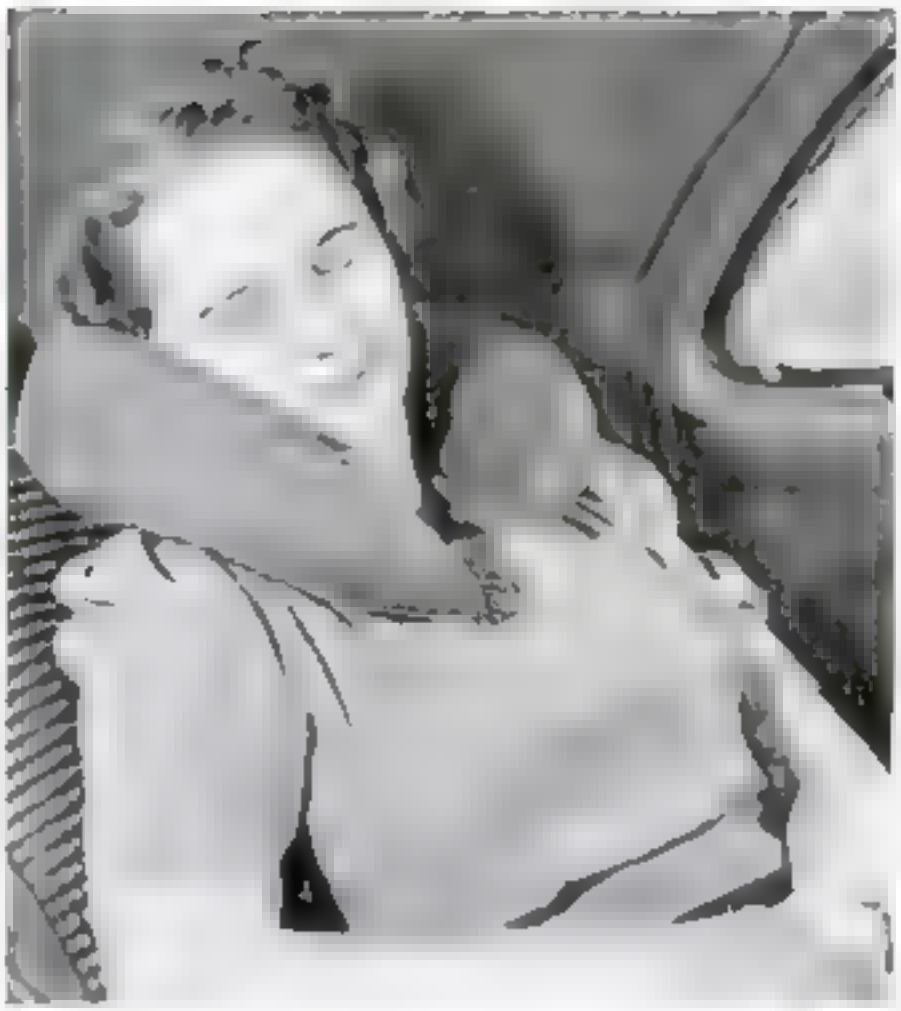
The chemicals used to fortify the natural oil are solvents, which were selected after several years of research. The final compound acts like a cleansing soap in carrying dirty deposits from engine surfaces. The treated oil also holds carbon and other products of combustion in minute suspension, literally grabbing each particle and surrounding it with a thin film. By insulating the particles, the compound gives them no chance to form coatings on bearings, cylinder walls, and pistons.

Unlike oils which "run away" from heat, the new compound is attracted to hot spots, thus carrying lubrication to areas where it is most needed.

In this engine, 6,600 laboratory "miles" of tests were run at speeds equal to 62 miles an hour on the road. Actual road runs also tested out the lubricant

A laboratory worker is shown with the apparatus in which additives, solvents, and other chemicals were mixed to find those which would stand up under heat

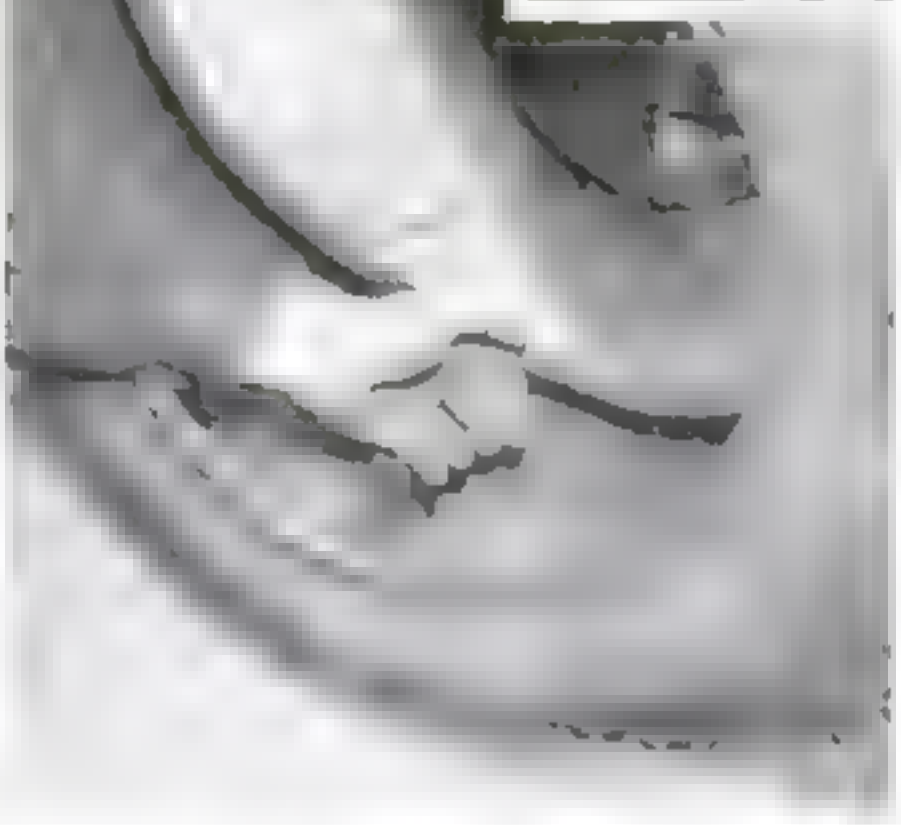
Auto Ideas

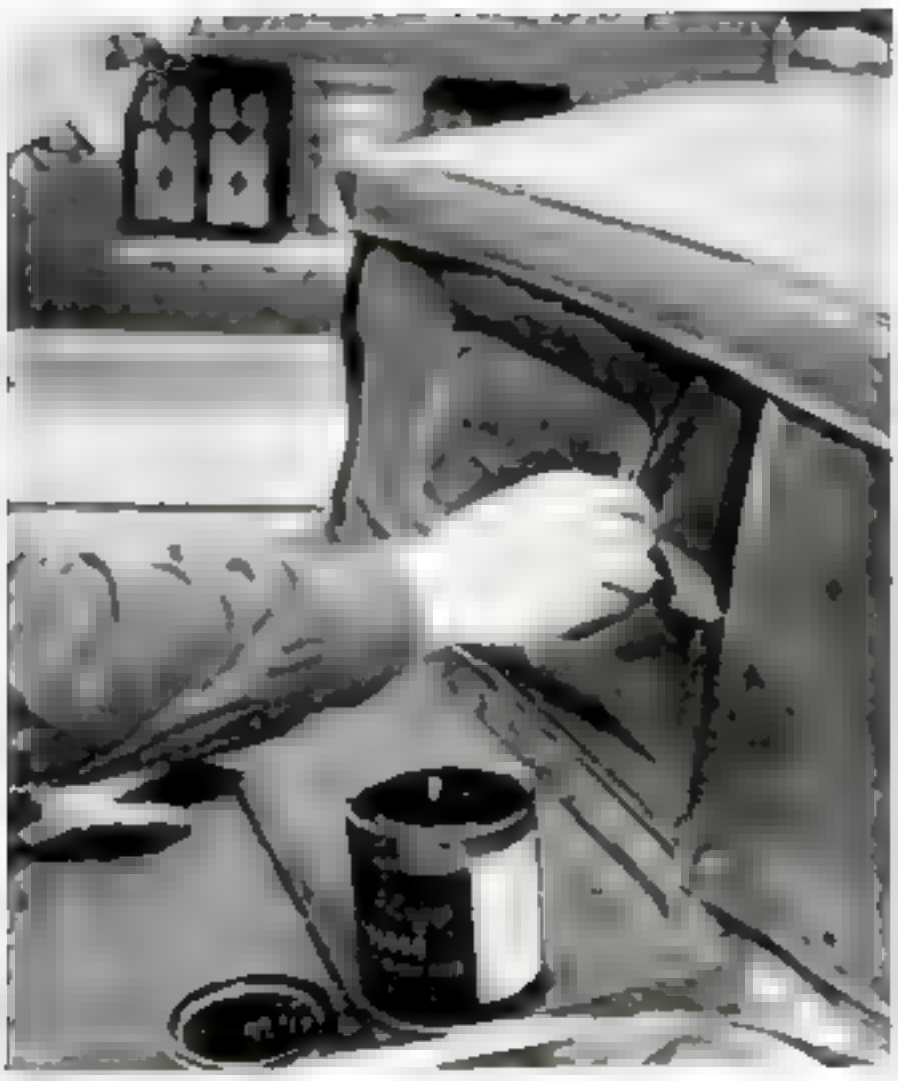


A COMBINED HEAD AND NECK REST for car passengers fits around the wearer's neck and rests on the shoulders. Comfortable support is thus provided for naps or for just plain relaxation. The neck rest is narrower where it contacts the nape of the neck and the seat back, to allow the head to rest comfortably against the regular seat cushion. Kapok-stuffed, the pillow is finished in a soft material for which a taupe cover with a slide fastener is available when used in a car. It is said to be especially helpful to invalids and convalescents.

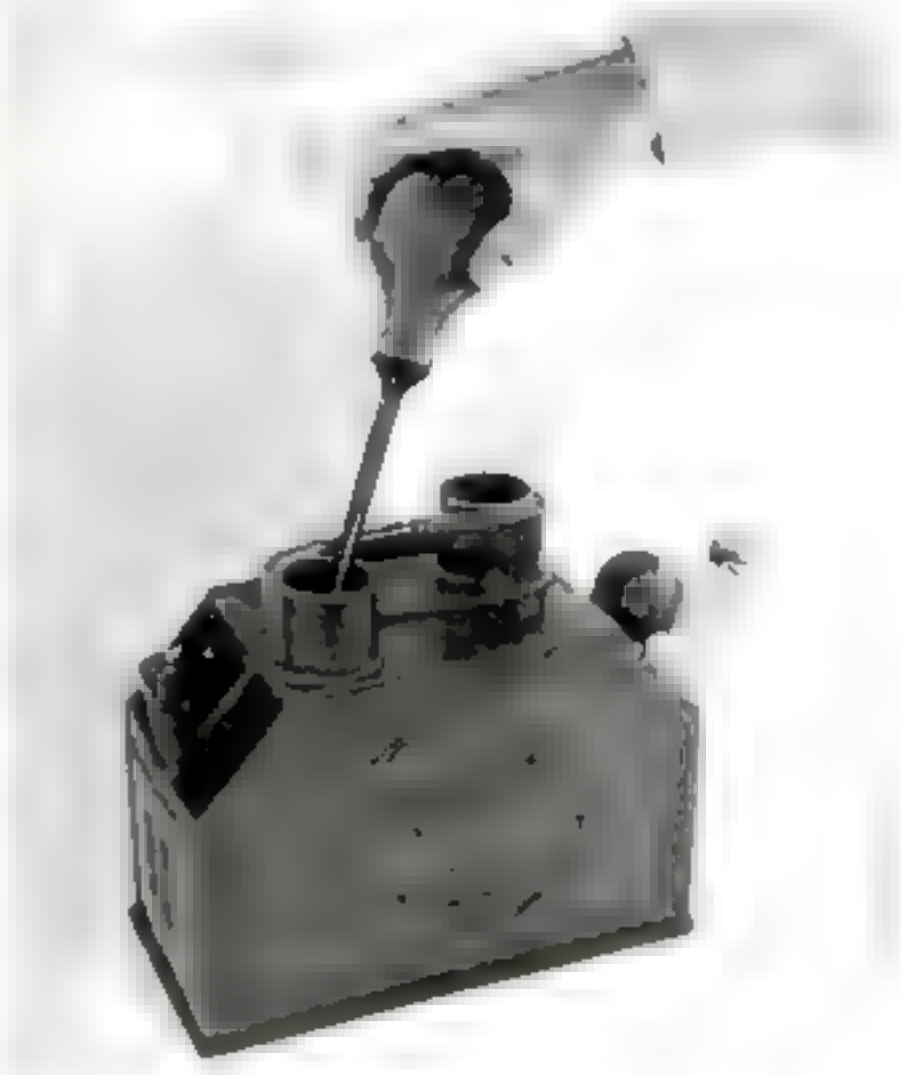
A NEW CAMBER ADJUSTER for car wheels of the knee-action type is said to do the job quickly and with accuracy. The unit consists of two arms, one forked at the end, which are hinged to provide a pair of jaws. Turning a threaded screw at the end opposite the jaws squeezes them together with great force. Clamped on the upright support arm, the tool can be used to bend the arm slightly to change the camber as desired. Depending on how the tool is attached to the support arm, the camber of either front wheel can be increased or decreased.

NAIL HOLES IN TIRE CASINGS are easily and permanently repaired with plugs that are simply inserted from the inside. The plugs are made of a new-type material and have a special convex molded head covered with self-vulcanizing, raw-rubber gum. It is claimed that the plugs bond themselves securely to the casing, and the soft rubber flows into the cavity under the influence of pressure from the inner tube and the frictional heat developed by the tire when in use, thus keeping out dirt and water and preventing casing rot.



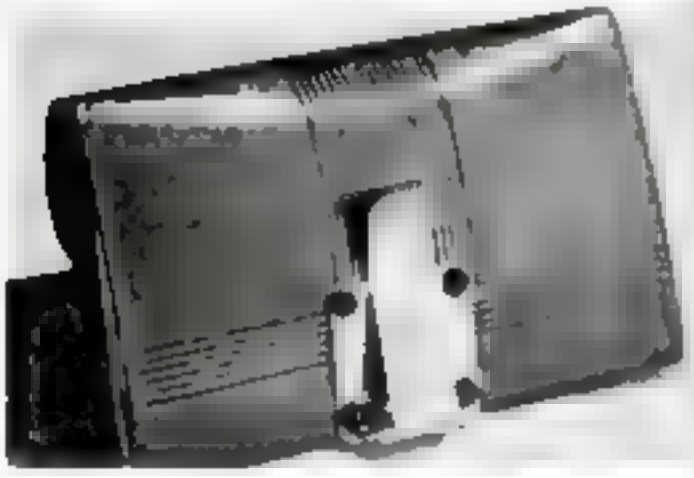


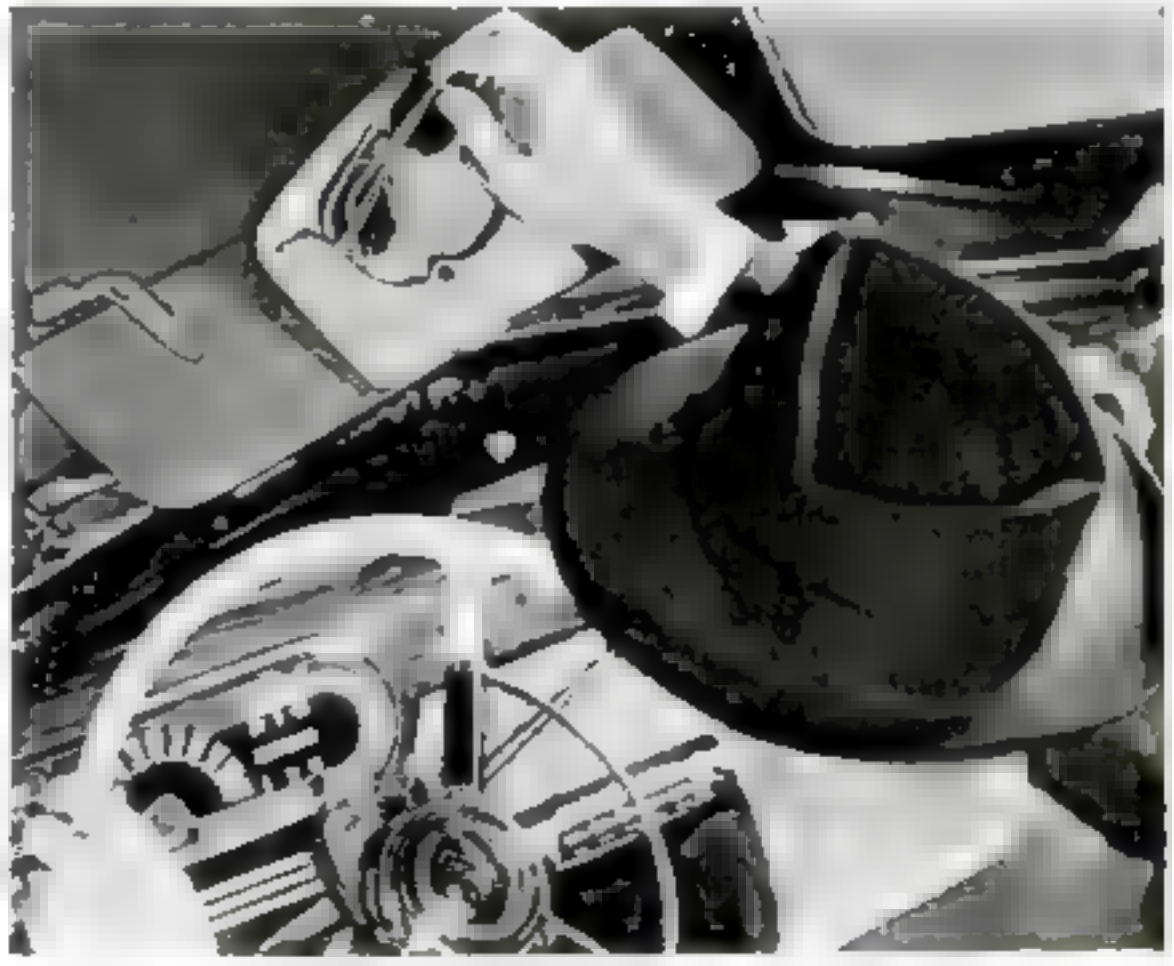
A BATTERY SERVICE KIT to speed service-station work is not only made of an unbreakable, lightweight plastic material, but holds everything that might be needed for checking a battery's condition without taking it from the car. Built-in compartments hold water, a hydrometer, tools, pouring spouts, can opener, and a battery filler. A convenient handle makes carrying easy.



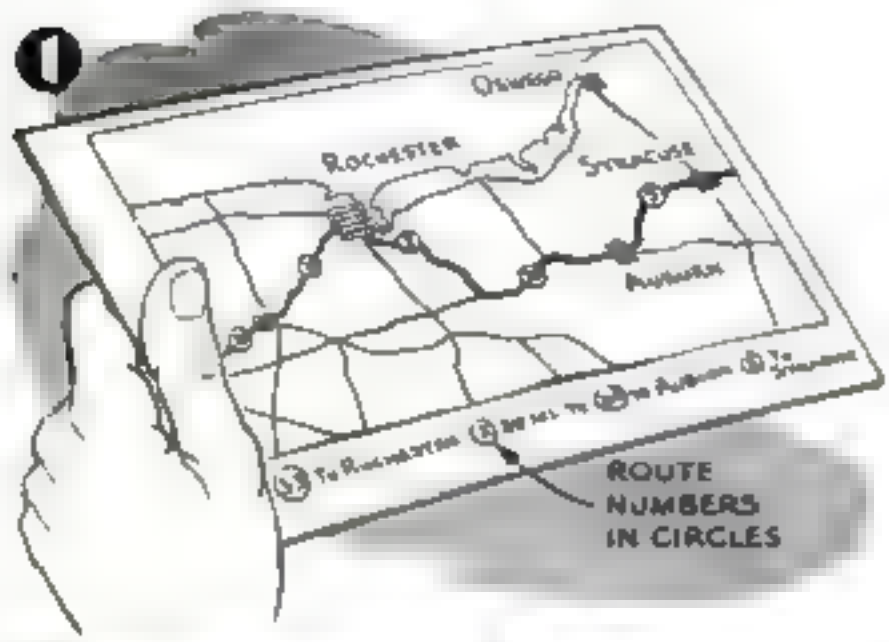
TOP DYE FOR CONVERTIBLES, which is said to be neither a paint, a top dressing, nor a water repellent, is now available in black or tan for restoring tops to their original luster. It is described as a "pigment emulsion," made from pigments specially selected for their fastness to sunlight. It is applied with a brush or spray gun.

A LEATHER CASE that may be slipped on the sun visor of your car holds sun glasses, cigarettes, pencil, or other objects within easy reach at all times. A strong steel clip fastens the case in place, while the flap is provided with a snap button to keep the contents from spilling out. The manufacturer also offers as optional equipment a pair of sun glasses specially designed to filter out rays of sunlight that hamper driving vision.

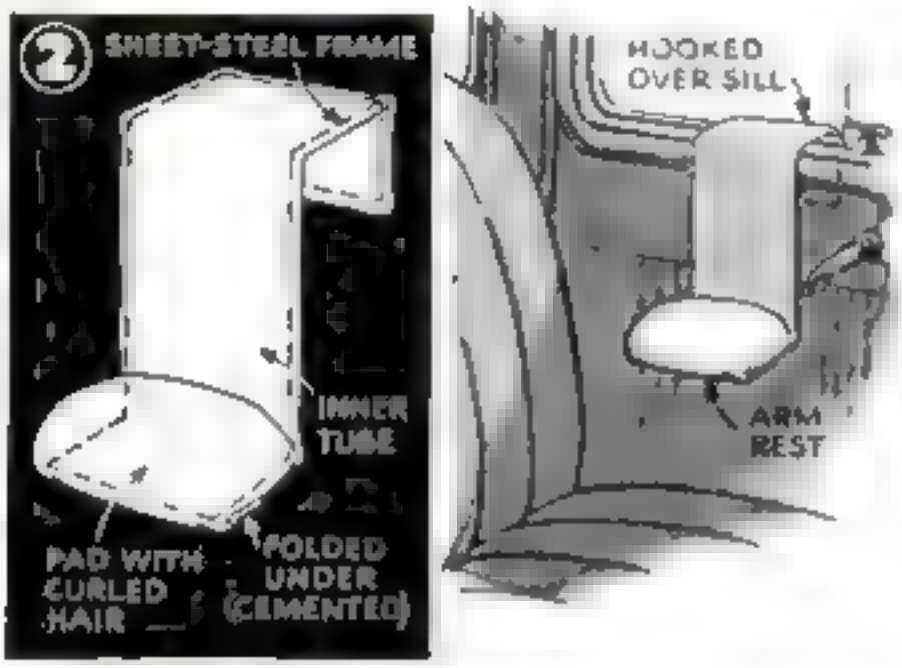




SEVEN HANDY TIPS



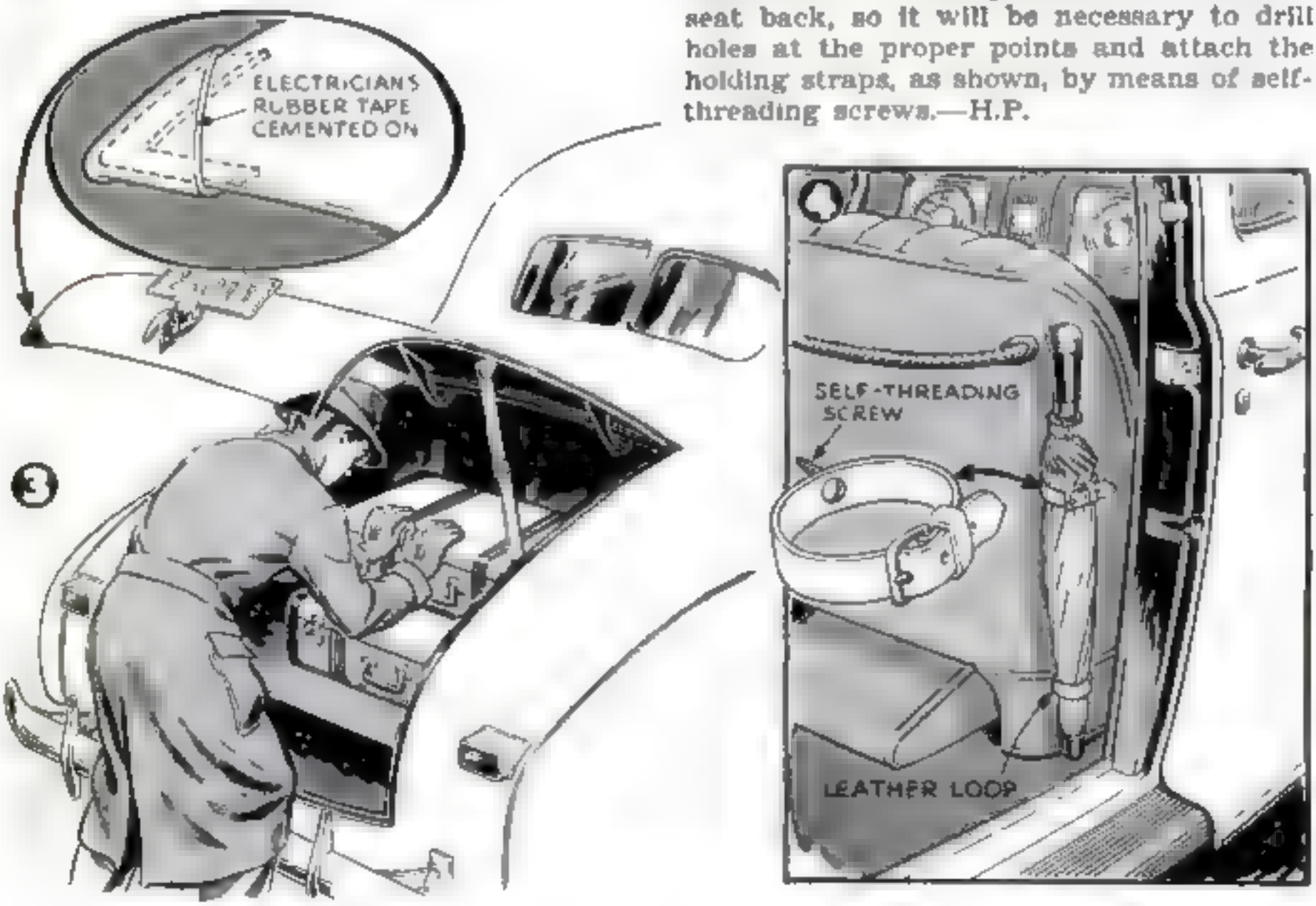
1 EASILY HANDLED STRIP MAPS for your cross-country motor trips can be made from ordinary road maps. Cut out the section of the map your route covers and paste it on a card, leaving a space at the bottom. In this space, print the highway numbers and distances between highway junctions, as shown at left.—D.B.J.



2 A DRIVER'S ARM REST can be made from a piece of sheet iron, some inner tube rubber, and the stuffing from an old seat cushion. Cut and bend the metal to fit the window ledge and your arm. Then cover it with rubber, which should be cemented in place. Before sealing up the end, pack the cushion stuffing inside as padding.—N.L.K.

3 SHIELDED DECK-LID CORNERS will help to protect your head should you accidentally bump the corners when the lid is raised. Electrician's rubber tape of the type that is adhesive on one side may be attached inconspicuously to the edges as a safety precaution. It should not interfere with tight closing of the lid.—W.E.B.

4 MOUNT AN UMBRELLA behind the front seat of your car where it is out of the way, yet handy if you are caught in the rain. Sheet steel is usually the material of the seat back, so it will be necessary to drill holes at the proper points and attach the holding straps, as shown, by means of self-threading screws.—H.P.

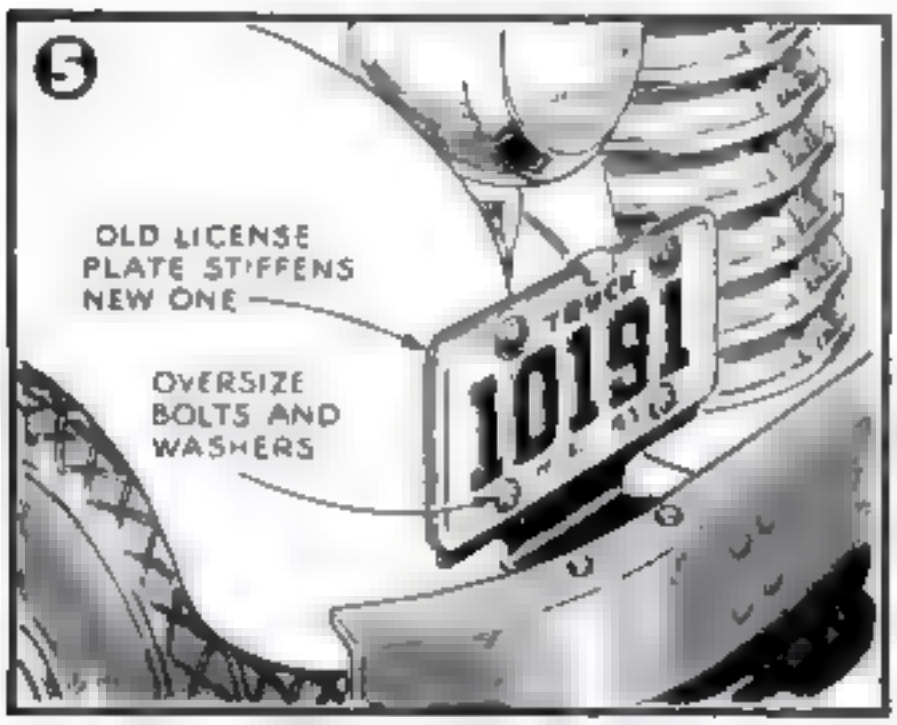


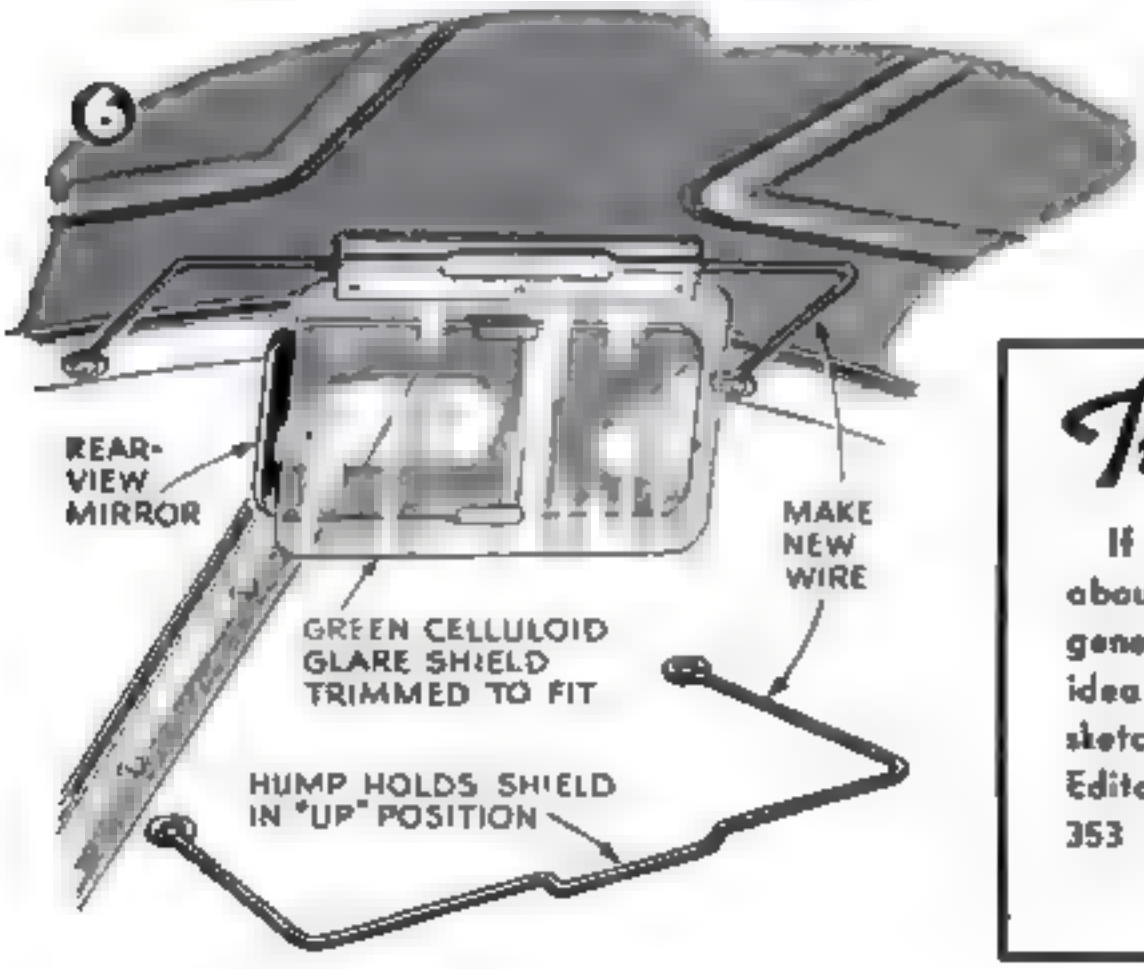
FOR CAR OWNERS

5 LICENSE-PLATE STRENGTHENERS for heavy trucks on which vibration often tears the sheet metal can be made with—hold your seats—more license plates! Just slap your expired plates against the backs of the new ones, and bolt them in place.—A.H.

6 TO REDUCE HEADLIGHT GLARE from your car mirror, replace the wire and rubber cups of a five-and-ten green celluloid shield with a new wire. Bend a hump in the new wire similar to the old one so the shield will snap up or down. With round-nose pliers, loop the ends of the wire to required needs of your car so that the unit can be attached over your mirror using the existing windshield molding screws.—D.C.

7 DASHBOARD HAND GRIPS for youngsters who like to stand up in the front compartment of a car make it easier for them to keep their balance as the car rounds corners. Ordinary screen-door handles bolted in place through holes drilled in the top of the dash make a neat job and will withstand much tugging.—I.B.G.





DRAWINGS BY
STEWART ROUSE

Think—OF AN IDEA!

If you would like to let others know about your pet auto tip—and get paid generously for doing so—just write your idea in 100 words or less, draw rough sketches, and send them to the Automobile Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

Wally, anxious to be useful, brought over a pail of cold water and prepared to pour it into the radiator. "Hey!" Gus cautioned. "Let her cool!"

GUS settles an account

Joe Clark may think it is poor business to rib a customer, but the Model Garage proprietor is willing to pass up cash now and then for the sake of a laugh

By MARTIN BUNN

IT WAS eight o'clock on a bright winter Monday morning. Joe Clark, his hands full of time-and-material slips and his eyes serious behind his rubber-tired spectacles, was fussing around the four or five cars standing in the Model Garage shop. "Piling up on us again," he said fretfully.

Gus Wilson stretched himself and interrupted his partner with a loud and impolite yawn. Then he grinned widely. "Take it easy, Joe," he advised good-naturedly. "Starting a week's work by getting yourself all hot and bothered trying to do half a dozen things at once is just about as sensible as trying to drive 50 with a cold engine."

Joe went into the office a little huffily. Gus grinned after his indignant back and thought that after a while he'd make some excuse to go in and kid him along enough to smooth down his ruffled feathers. Just then a horn began to honk outside the closed shop door. Gus turned to Wally, the latest of a long succession of grease monkeys. "Open the door," he said, "and let that squawker in."

Wally slid the door open and a well-kept sedan of last year's vintage was driven in, a haze of steam issuing from under it.

From the sedan emerged a large and flashily dressed man with a red face, and before the visitor's highly polished shoes had hit the cement floor Gus saw that he was blazing mad.

"This—this—this—car is driving me crazy!" he sputtered.

Gus smothered a grin by looking sympathetic. "They can do that sometimes," he admitted. "What's the trouble?"

"Don't stand there like an idiot asking me fool questions!" snapped the visitor. "Do something! Can't you see that my motor's red hot?"

Gus Wilson isn't used to being spoken to

in that tone of voice, and he felt his own face getting red. Then he thought better of it, and laughed. "Your radiator is boiling a bit," he conceded. "Switch off your engine, will you?"

The engine stopped. Gus raised the hood and unscrewed the radiator cap cautiously. From the filler pipe there erupted a large cloud of dry-looking steam.

Gus whistled. "You ran it mighty close that time, mister," he said. "There can't be more than a gallon of water left in your whole cooling system."

Wally, anxious to be useful, brought over a pail of cold water and prepared to pour it into the radiator. "Hey—not yet!" Gus cautioned him. "Pouring cold water into a bus that's as hot as this one is—why, kid, it's just asking for a cracked cylinder head or engine block or warped valves. Let her cool off for a while."

"I'm in a hurry!" snapped the large man.

"Are you, mister?" Gus said coolly. Then he added: "What name did you say?"

"Pickett—Robert J. Pickett," the other told him importantly. "Does it mean anything to you?"

"Sure," Gus said promptly. "Pickett's Charge—Battle of Gettysburg."

Unexpectedly Pickett's face split in a broad grin. "One hundred percent wrong," he said. "My first principle is not to let anyone charge anything. I'm Pickett's Cash Stores—got a round dozen of 'em in upstate cities."

"Oh," Gus said without enthusiasm. "That Pickett. I bought a pair of fishing pants in one of your stores last summer. Most of the buttons came off the first day I wore them, and I threw them away."

"You should have taken 'em back," Pickett told him breezily. "Now about my car. How soon can you fix it?"

"That depends mostly on what's the matter with it," Gus said. "When did you begin to have trouble with overheating?"

"Saturday morning I smelled steam," Pickett told him, "and saw that the hand was way over beyond 200 degrees. I had to stop for water two or three times, and each time after I'd had the radiator filled up she'd go along all right for 15 miles or so.

"When I got into Newton about noon I drove right to a garage and told 'em to fix up whatever was wrong. I was busy in Newton all afternoon and evening, and stayed there Sunday playing golf, and didn't use the car. I've got a very important engagement down in the city today, so I started early this morning. The garage mechanic who brought the car around to the hotel said that the overheating had been caused by a loose fan belt, and that he'd put on a new one. He said it ran too cool, then, but that he'd fixed it. On my way back upstate I'm going to stop off long enough to get that smart aleck fired! How far is it from Newton here—thirty miles, ain't it? Well, I've had to stop for water seven times—and now I'm laid out here. What the devil's the matter with my car, anyhow?"

"Well," Gus said reflectively, "the trouble is one of two things—either your engine is producing too much heat, or your cooling system isn't doing enough cooling."

Pickett stared at him suspiciously. "You ain't trying to kid me are you?" he demanded. "That ain't healthy, mister! Oh, well, let it slide. I've got to get down to the city. Whatever's the matter with my car, for the love of Mike fix it so that I can get going!"

"That's easier said than done," Gus told him. "I've got to find the trouble before I can fix it, and that may take anywhere from ten minutes to a couple of hours. And there are jobs in the shop that will have to come before yours. You had better fill up your radiator and take your bus to some other garage. Or you can leave it here, get a taxi to take you to the railroad station, and go down to the city by train. If you want to do that, give me a phone number where I can reach you in the city, and I'll call you when I've found out what's the matter with your car and how long it will take us to fix it. That's the best I can do for you, Mr. Pickett."

Pickett both stormed and coaxed, but Gus

Joe picked the slips out of the box into which Gus drops them. "What the devil is this?" he yelped. " 'One pair pants, $1.79.' "

wouldn't give way an inch, so finally the cash-store magnate, growling, went off in a taxicab.

After the irate Pickett had departed, Gus looked at Wally and grinned a little sheepishly. "Don't take the way I talked to him as an example of the way to talk to our customers," he warned. "He was a special case —the kind of big-mouthed guy I always take down a peg or two when I get the chance. Besides, one of his stores skinned me on those fishing pants. Do you know how to go about checking a car that's overheating?"

"Sure," the new grease monkey proclaimed confidently. "You see if the radiator is stopped up." He grabbed up his can of water and started for the blue sedan.

"Go easy with that water," Gus warned him. "Start the engine, and pour in just a little at a time That's right. Now let the engine idle for five minutes."

He came back when the five minutes was up. "Put your hand on the radiator, near its bottom," he told Wally. "That's right. Now near the top. Which is warmer, bottom or top?"

"There ain't no difference," Wally reported. "Yes there is, too. The top's a little the hottest."

Gus made the same easy test. "Right," he said. "The top feels just a little warmer, but there's very little difference between top and bottom. That shows that the radiator isn't clogged. If it were, the top would be a lot warmer than the bottom. Let's see, now."

He checked over the cooling system, and shook his head. "Nothing wrong there," he decided. "No signs of a leak anywhere. Overflow pipe is O.K. Hose is all practically new. Let's see that water pump. . . . Working fine. . . . The fan belt was new a few days ago, but it might have—no it's all right. . . . I'll have a look at that thermostat, though. Always check the thermostat when you're up against a case of overheating, Wally. If it fails to open properly it makes the engine run too hot, and if it fails when it's in the open position it lets it run too cool."

He removed the thermostat and took it over to his workbench. Then he filled a small can with water, dropped the thermostat into it, put a thermometer beside it, and set the can on a lighted gas plate. When the thermometer registered 160 degrees, the thermostat opened. Gus fished it out of the can with a piece of bent wire. As soon as it was in the air it closed. "Nothing the matter with that," he said. "Jack up the rear end and we'll have a look at the brakes."

But the brakes weren't dragging.

"It must be the engine," Gus said. He replaced the thermostat. Then he checked the carburetor and the timing. Both were O.K.

Gus whistled tunelessly as he stared at the engine. Then he went over to the glass-fronted cabinet in which he keeps his instruments and precision tools, and came back with a compression tester. "What's that thing for?" Wally wanted to know.

"It shows up leaky piston rings, for one thing," Gus told him. "Sometimes a bad piston or bad rings cause overheating. He took out all the spark plugs and dropped about a teaspoonful of carbon remover in each cylinder. "That'll help loosen any gum that has formed on the rings or valves," he explained. "You get into the car, open the throttle all the way, and step on the starter when I tell you to," he instructed Wally. Then he pressed the tester's rubber adapter in a spark-plug hole and commanded "shoot!" As the engine turned over, the hand of the tester moved across the dial and stopped at a little over a hundred pounds. A test of each cylinder gave the same reading. "O.K.," he said. "The compression is good, and every cylinder is the same. Put the spark plugs back in, Wally."

He went over to the glass-fronted case and came back with another instrument. "It's a vacuum gauge," he said just as Wally got his mouth open to ask a question. "When an engine is normal the indicator hand shows 18 inches or more of vacuum and stays steady." He connected the tester's hose with the intake manifold. "Start her up. . . . Now keep her running steady at just a little over idling speed."

The hand moved to 18 inches, and stayed there.

Gus nodded. "That's all right," he observed. "There must be something else."

He did a half minute of heavy thinking. Then he drew the bayonet gauge out of the oil filler, and dabbed at it with his forefinger. "Mighty heavy oil," he said. "What's on the clock?" *(Continued on page 218)*

GUS SAYS:

You've reached a mighty critical driving period when you first find your brakes don't work perfectly. The only excusable trip you can make after that is a mighty slow and careful one to your garage. If it seems advisable, have your car towed there by a wrecker.

HOME *and* WORKSHOP

Toys FROM WALT DISNEY'S MAGIC REALM

Casey Junior, the hard-working little locomotive, and Dumbo's circus in winter quarters . . . All easy to make

NEXT PAGE

This wooden toy is patterned after a plaster model of Casey Junior built by Walt Disney's Character Model Department. The plaster original is shown on our Home and Workshop cover

CASEY JUNIOR

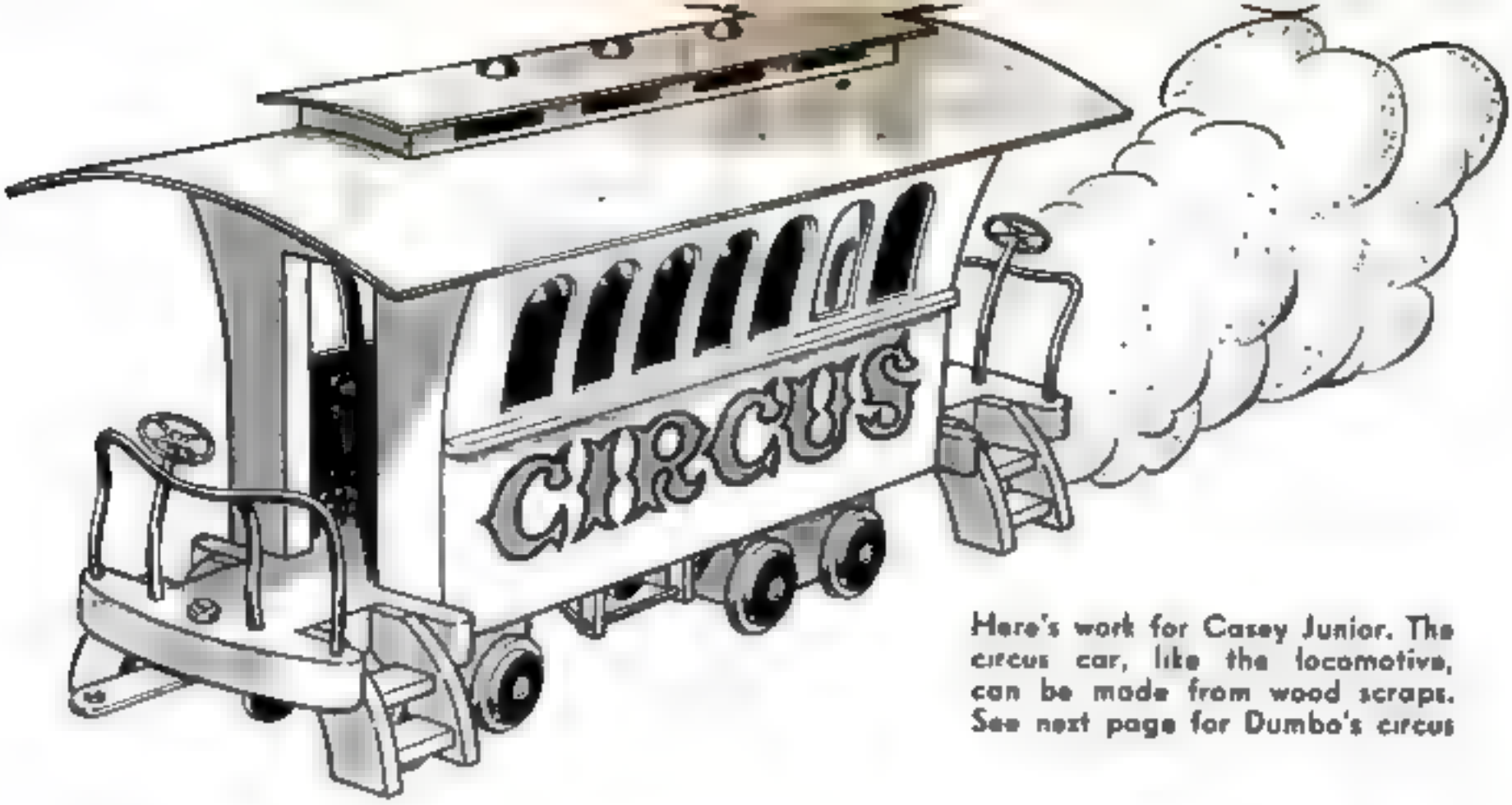
By HI SIBLEY

CHILDREN love the fanciful creations of that master of the play spirit, Walt Disney. They are sure to be captivated by the hard-chugging, almost human little locomotive "Casey Junior" in the new Disney release "Dumbo." What is more likely to delight a child than a sturdy wooden toy locomotive to pull around, attach cars to, and use with the cut-out circus animals, cages and buildings shown in the following article (pages 148-150)?

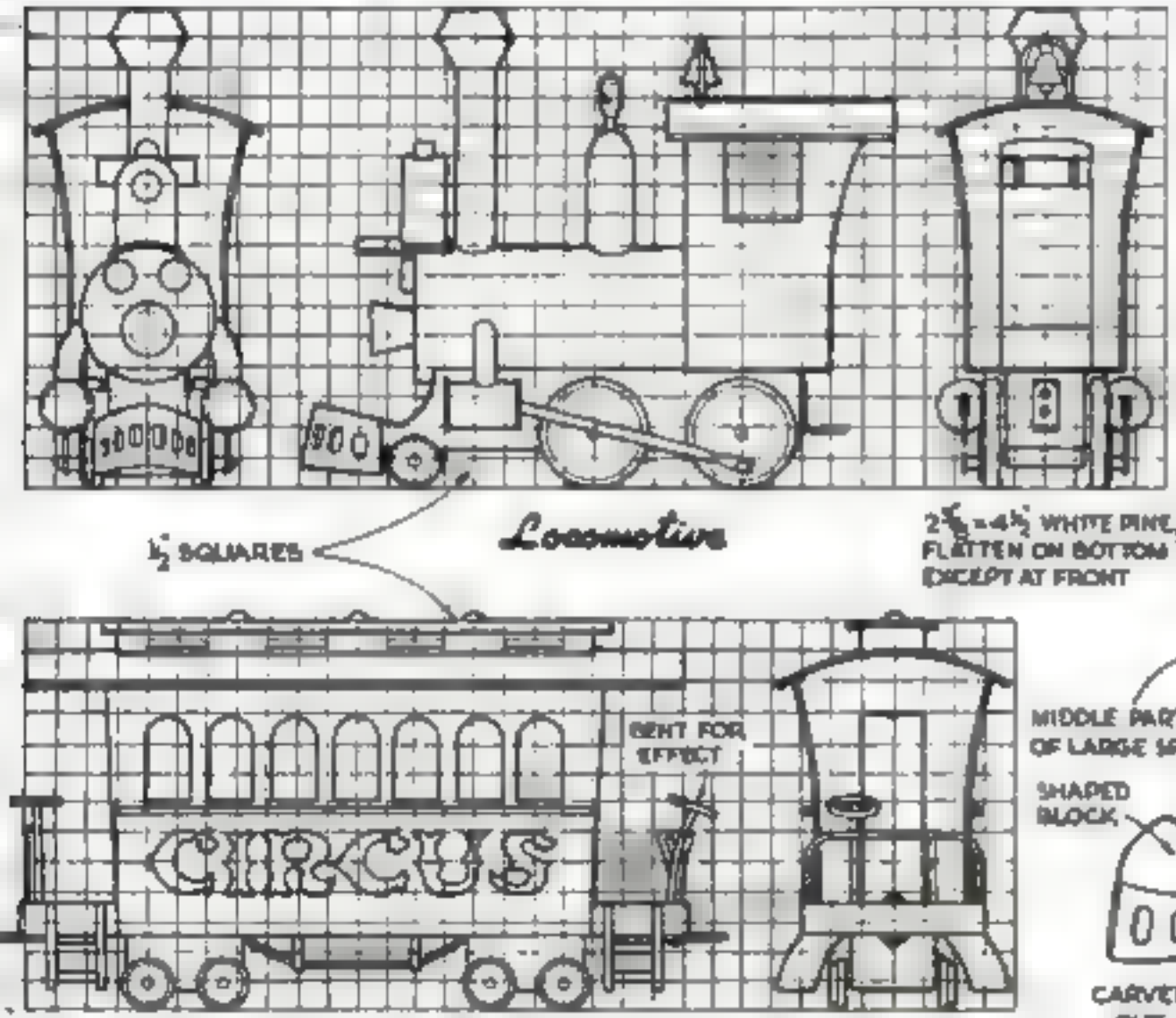
To make Casey Junior, shape a block of pine and drill the various holes to a turning fit for the axles, which may be cut from round metal curtain rod. Glue on the boiler, cylinder blocks and cylinders. Both steam pipes can be cut from a wooden curtain ring. Cylinder ends are cardboard or thin veneer. Cut a slot in each rear one for the piston rod. The cowcatcher is a solid piece, filed or sanded to shape.

You can turn the wheels in a lathe or make them by gluing cardboard disks to slightly larger sections cut from a rolling pin or curtain pole. The small wheels can be made by gluing together two fiber faucet washers of different sizes. Drill all the wheels to fit the axles very tightly, and rivet over the ends of the latter.

Dowel may be used for the stack and steam dome. The whistle is turned or whittled to shape. Drill holes into the boiler and glue in these parts. Glue and brad the sides of the cab and the cars to the ½" thick endpieces. Use heavy wire to represent the undercarriage of the cars and for the handrails at each end.

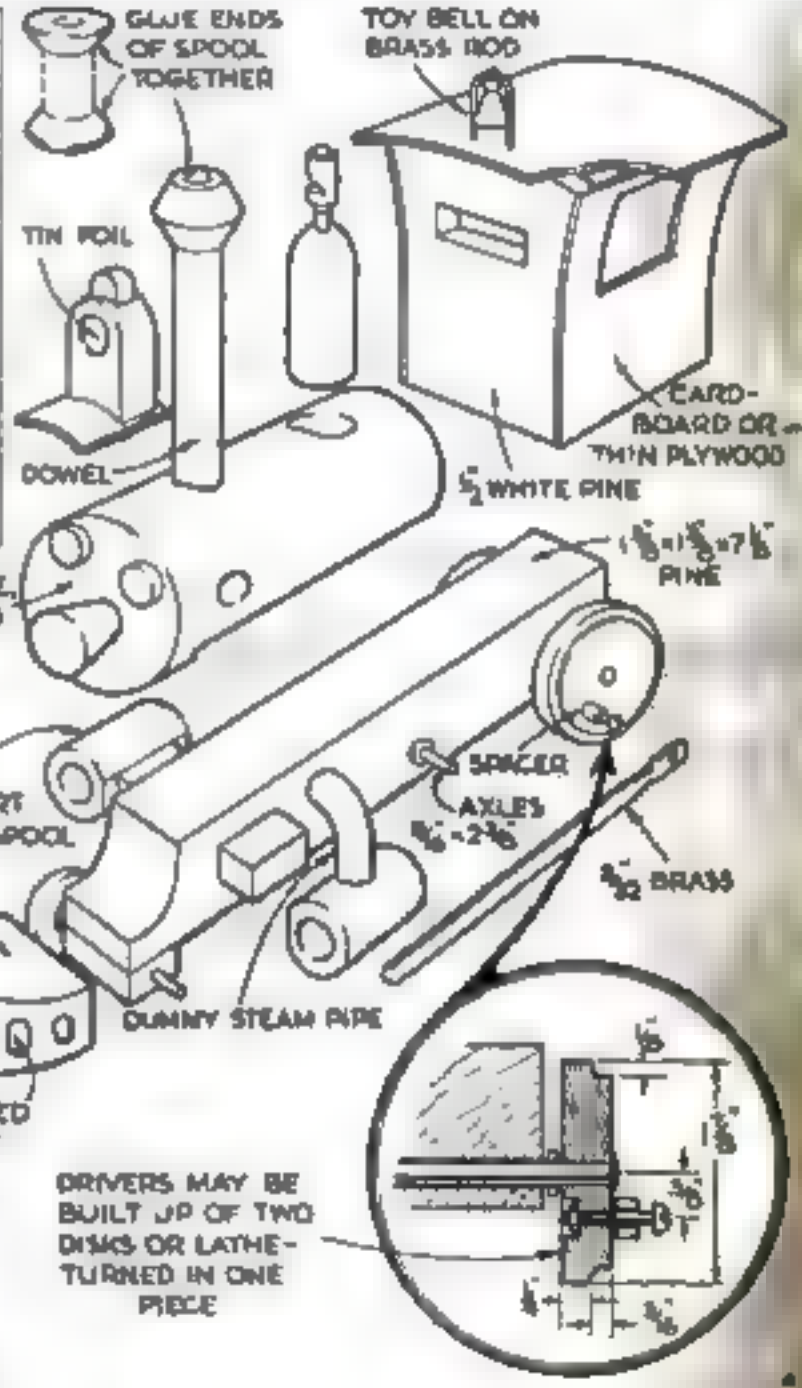


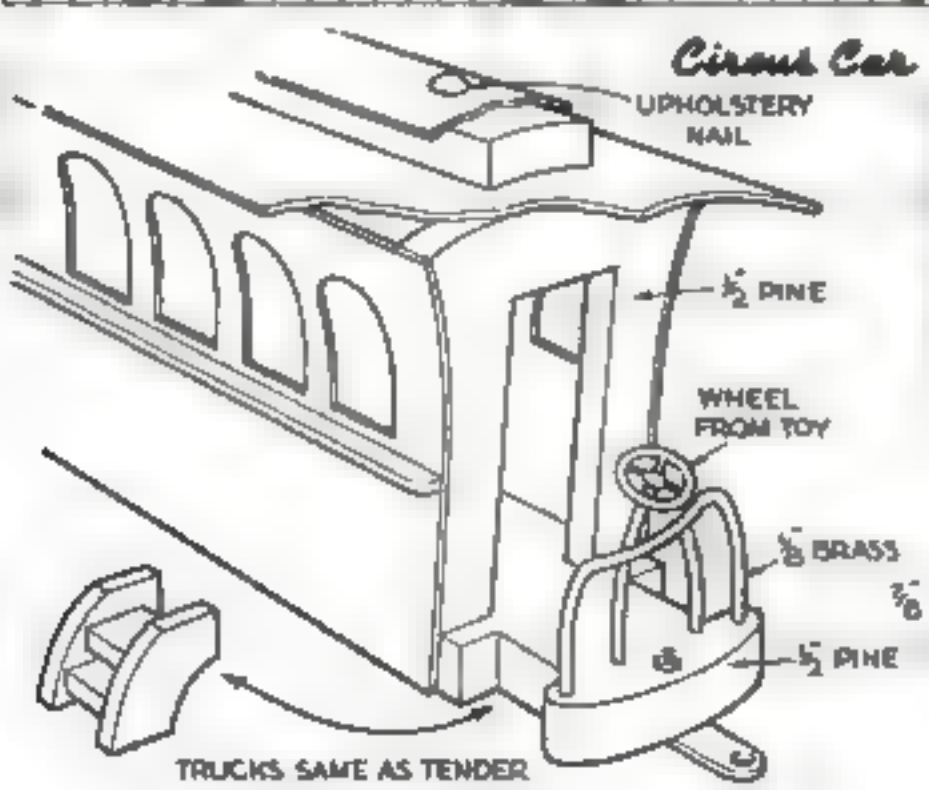
Here's work for Casey Junior. The circus car, like the locomotive, can be made from wood scraps. See next page for Dumbo's circus

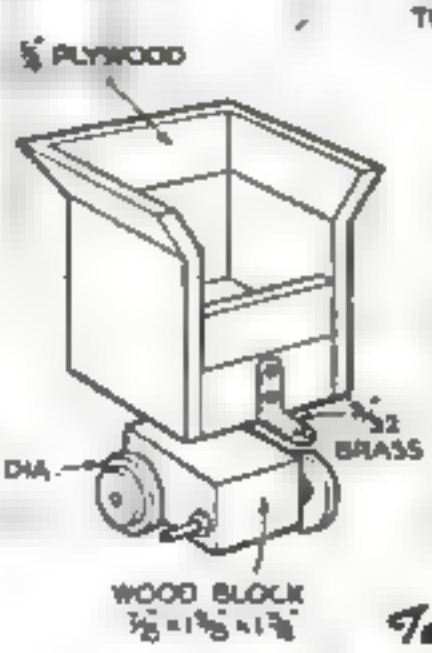


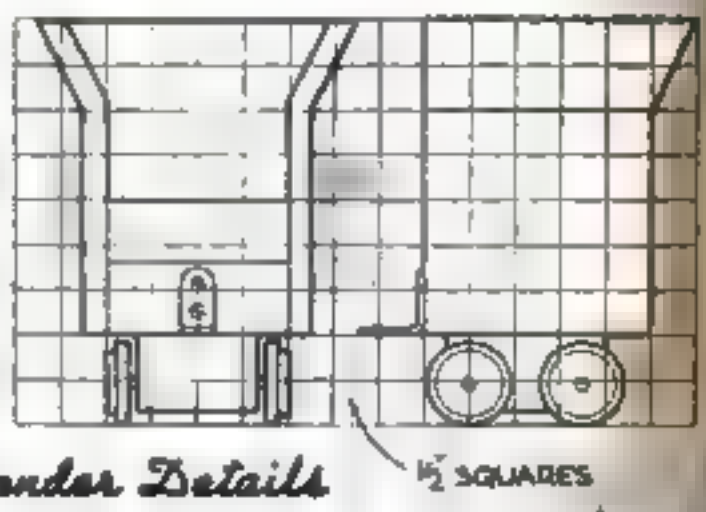
Locomotive

Circus Car









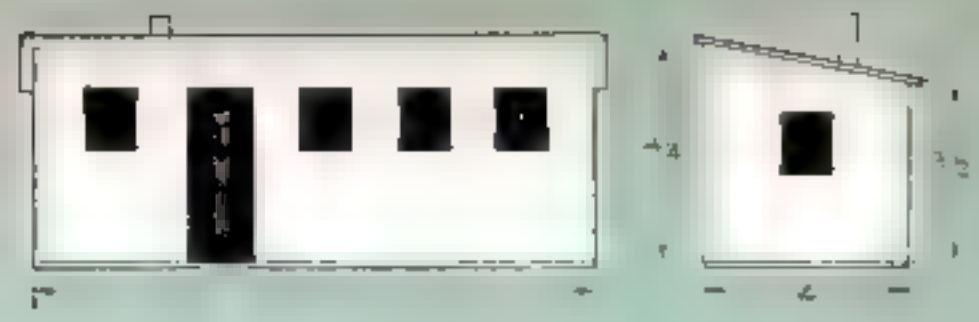
Tender Details

DUMBO'S CIRCUS IN WINTER QUARTERS

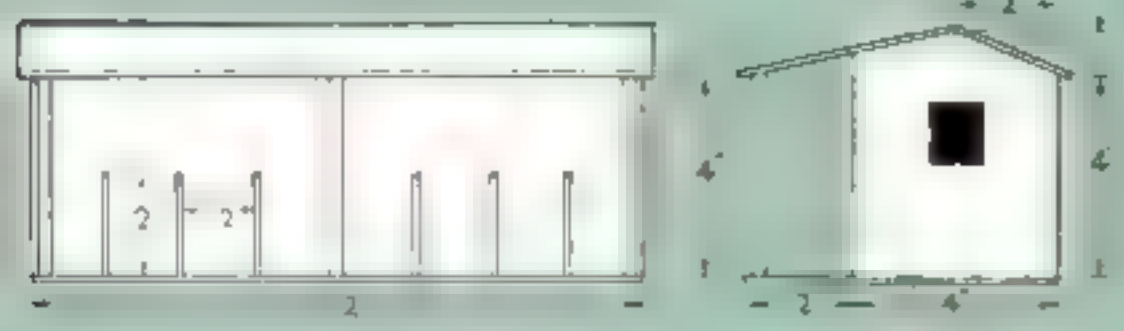
DUMBO, the baby-elephant circus star in Walt Disney's new picture, spends the winter in snug quarters under the warm southern sun. Here are simplified toy circus buildings, animals, and performers (see additional drawings on page 150). You can make them from scraps left over from larger projects.

Don't forget to cut a hole in the floor of one wing of the animal house so that it can be slipped over the giraffe. Lead disks for mounting the larger figures can be cast in a thoroughly dry plaster mold. Thin steel wire for mounting the bareback rider and the tight-rope performer can be bought from a model-airplane supply house.

Dumbo himself may well be made a little larger than scale size, but you can draw him larger or smaller by altering the size of the squares. Make the tent of tin or cardboard, cut an opening in one side, and glue cloth over all for a realistic effect. Pennants are cut from colored paper.

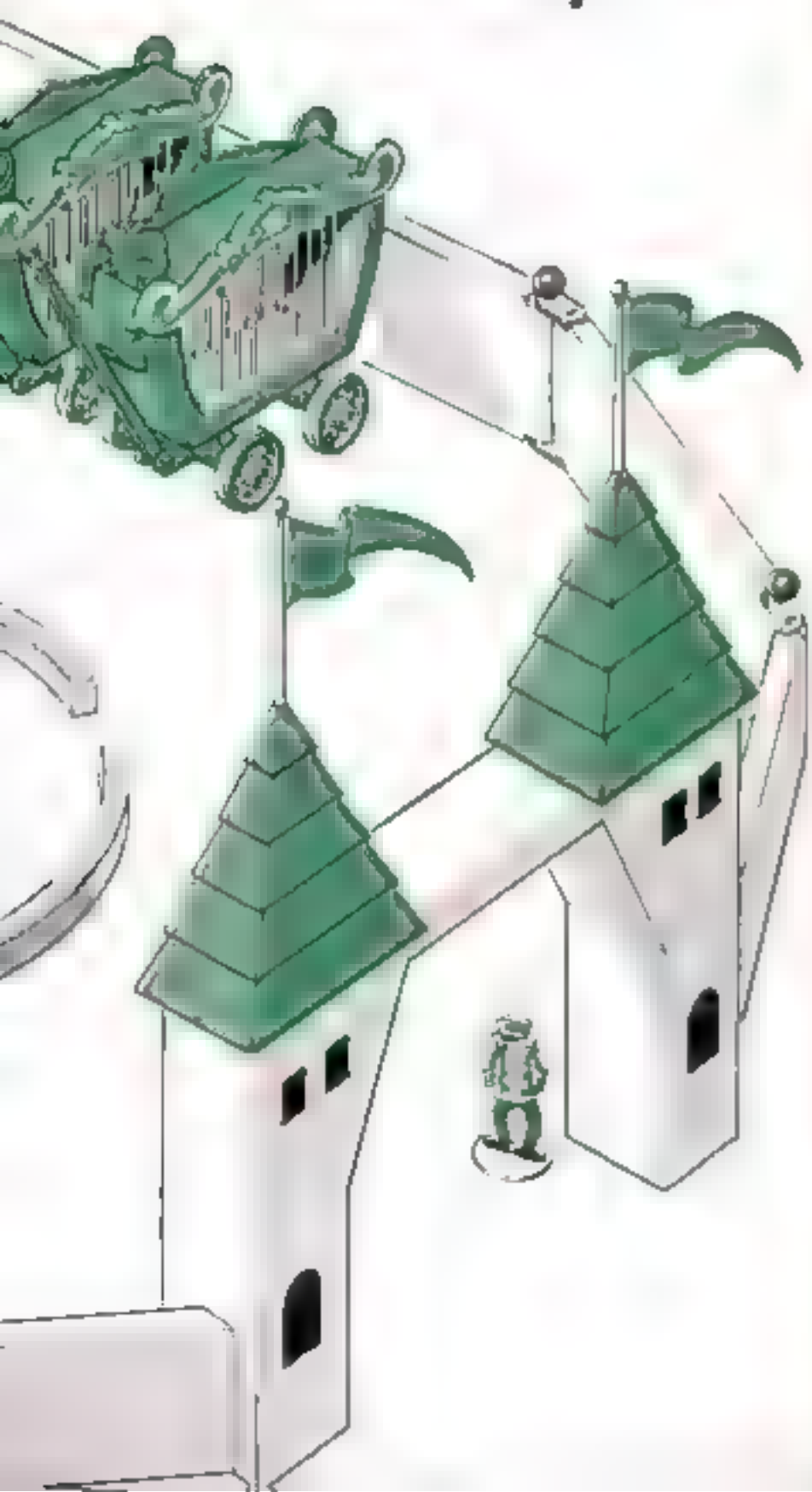


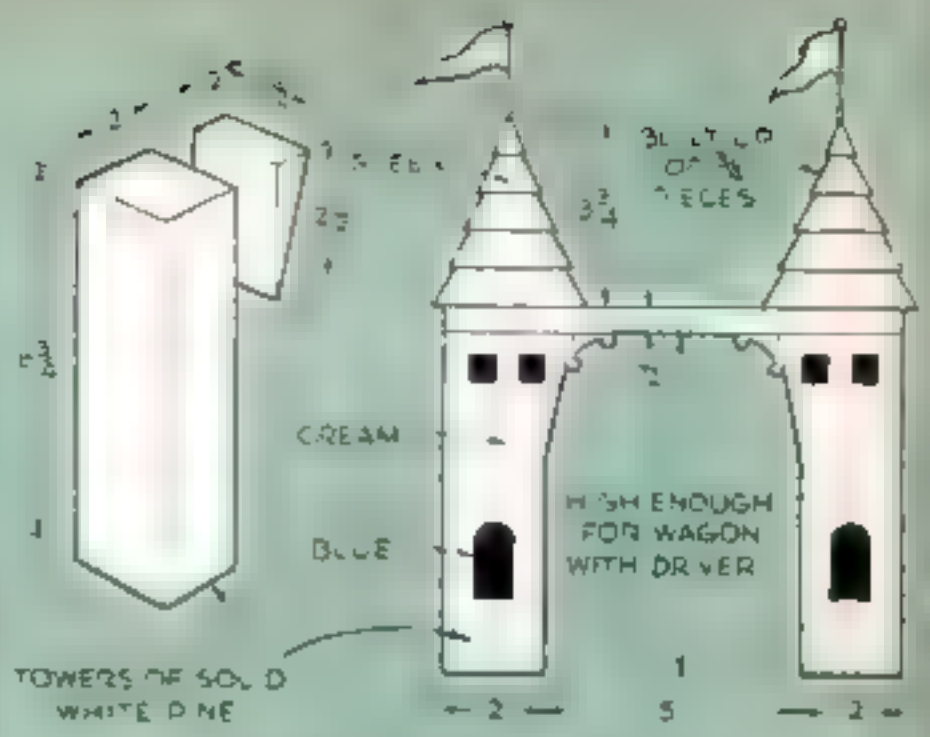
Dormitory

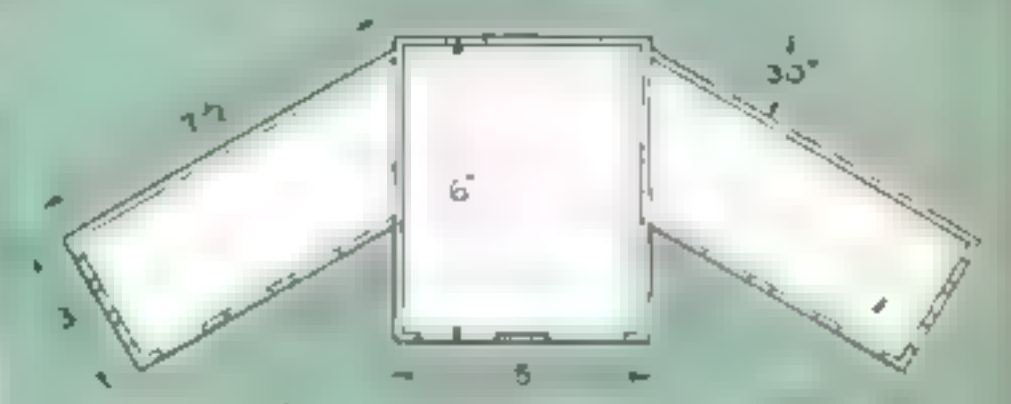


Stables

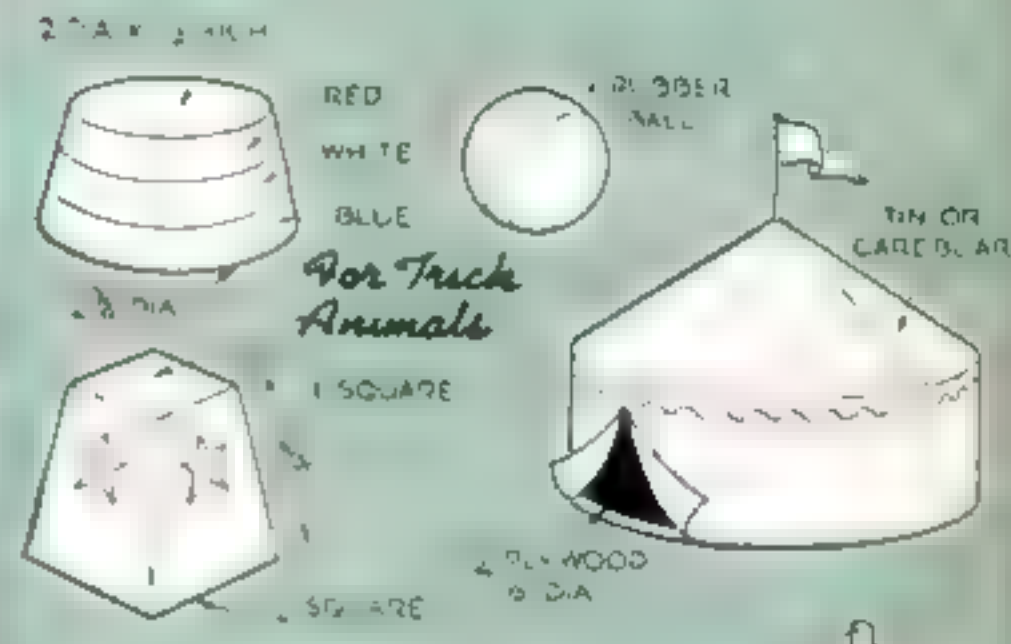
Circus Ring



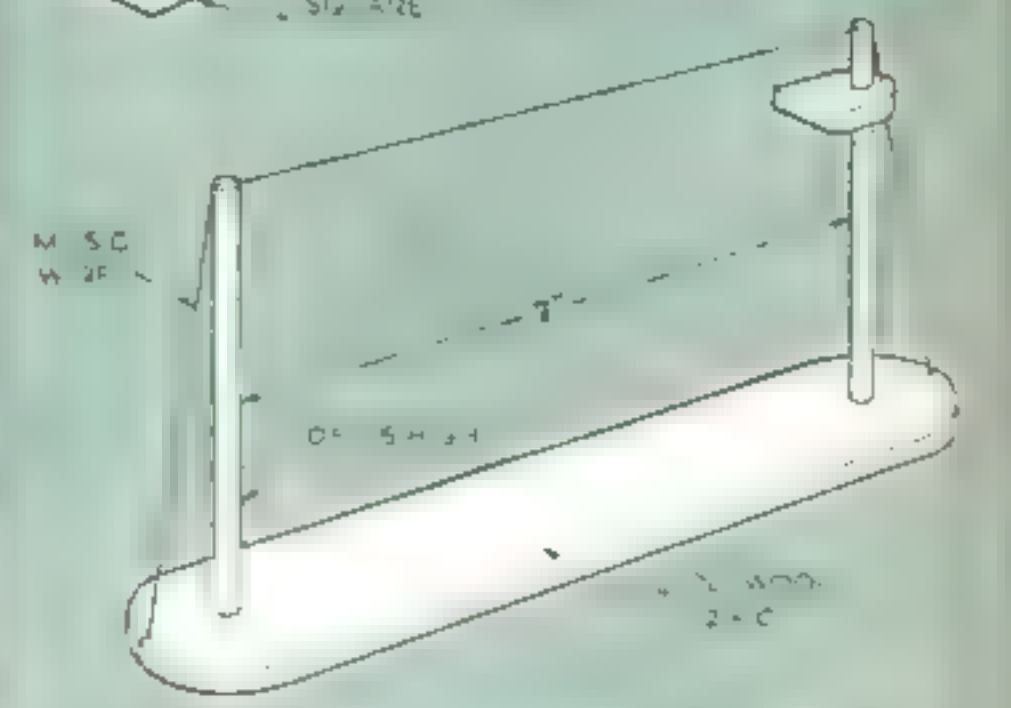




Animal House

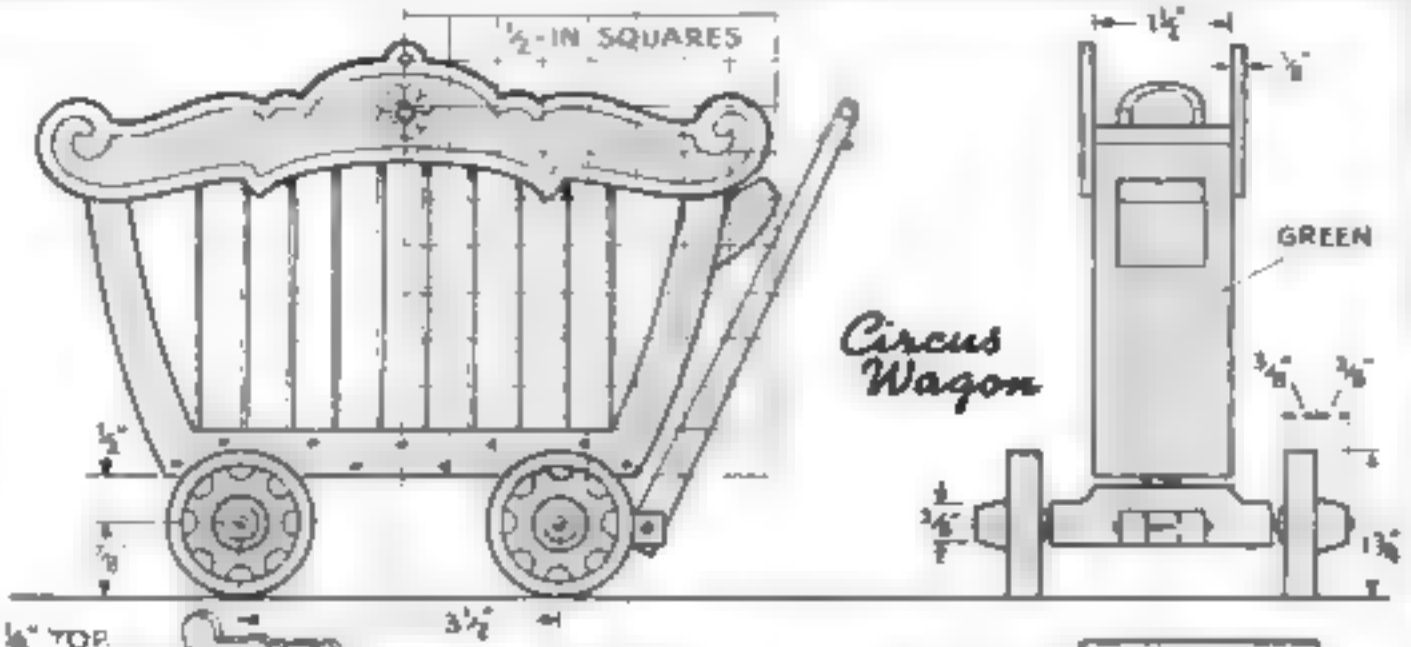


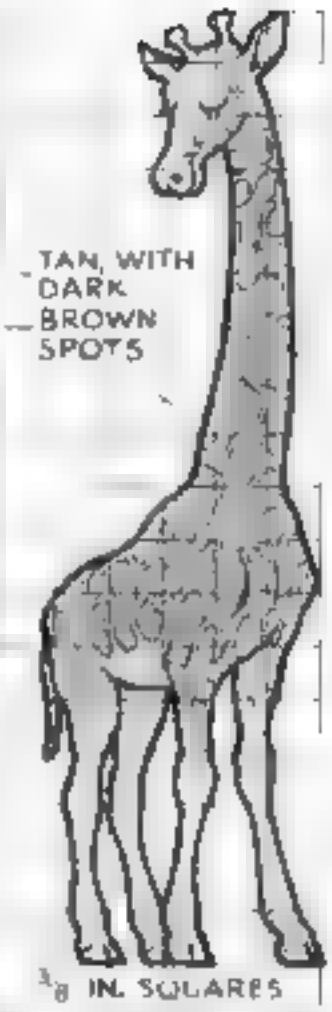
For Truck Animals

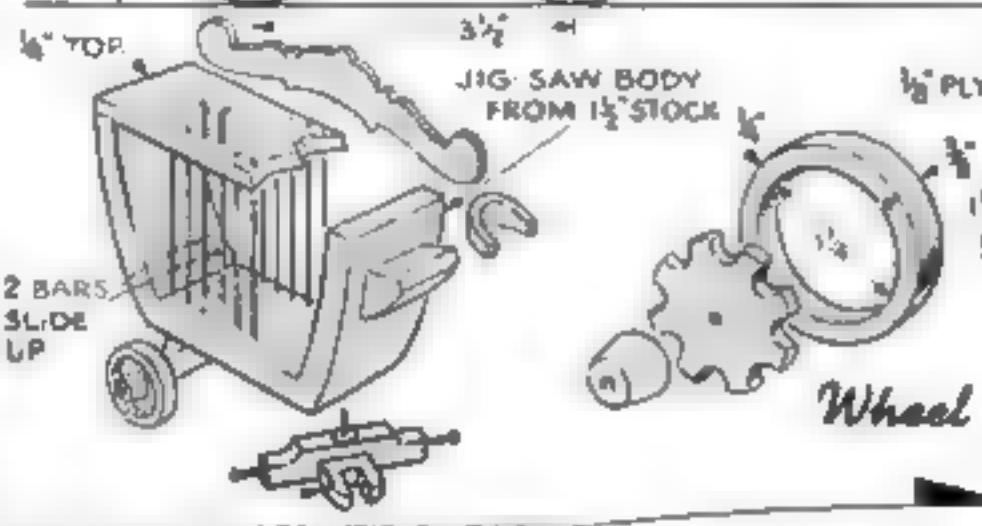


For the Tight-Rope Artists

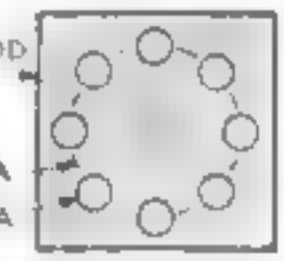
Circus Wagon





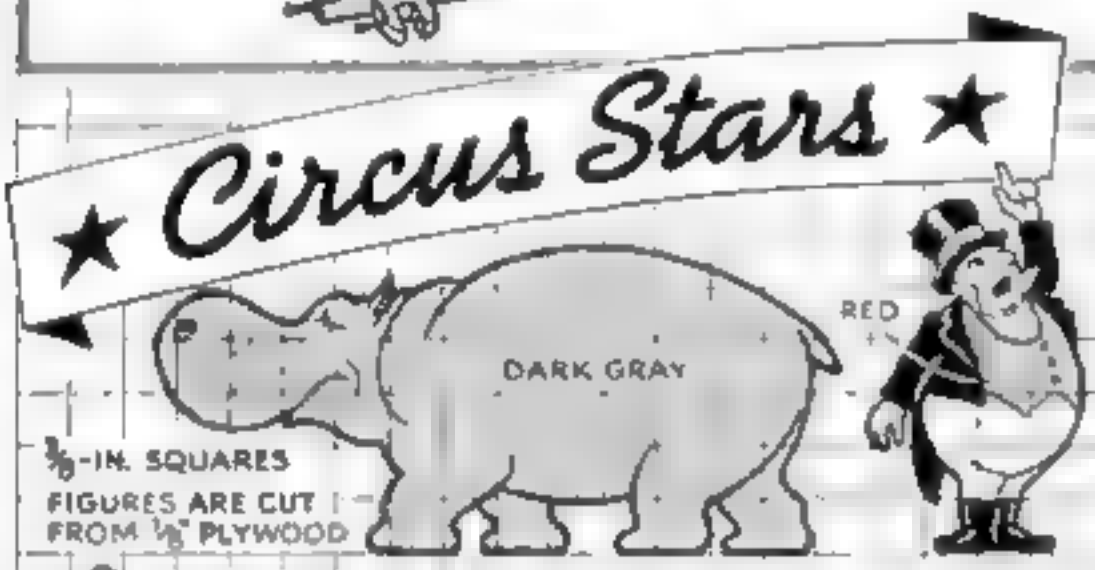


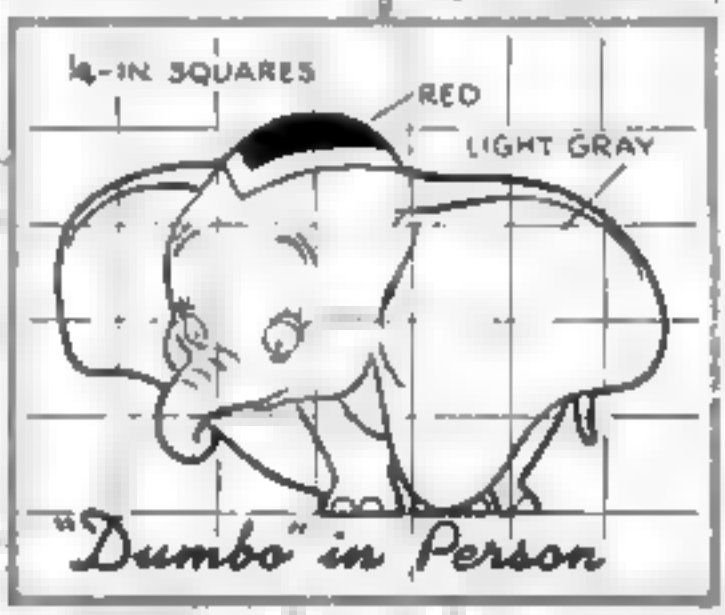
Wheel



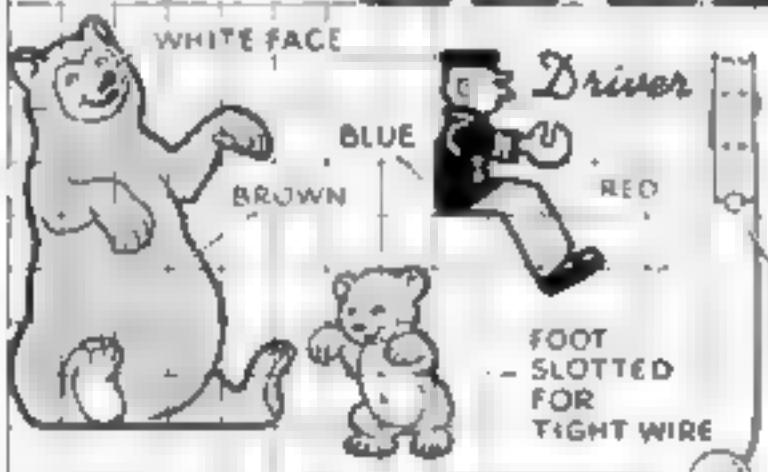
DRILL ⅛" DIA. HOLES, THEN SAW THROUGH CENTERS

★ Circus Stars ★

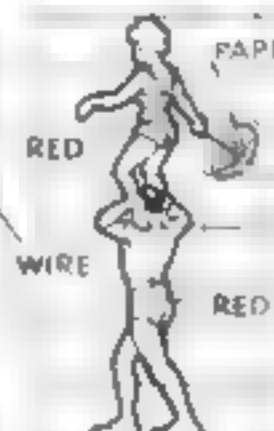


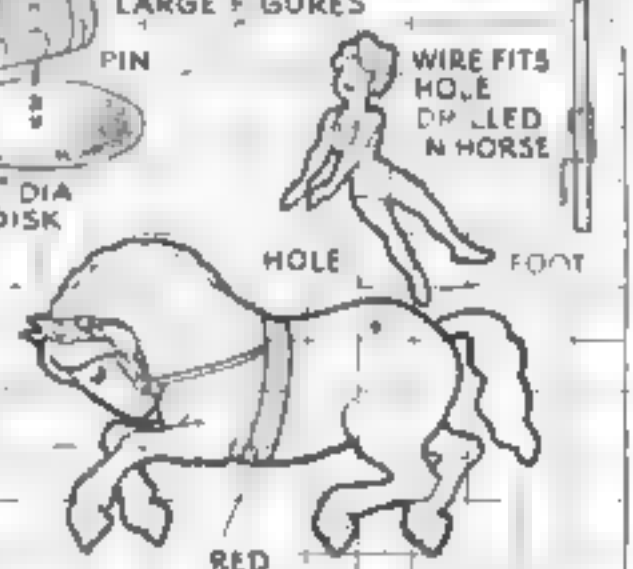


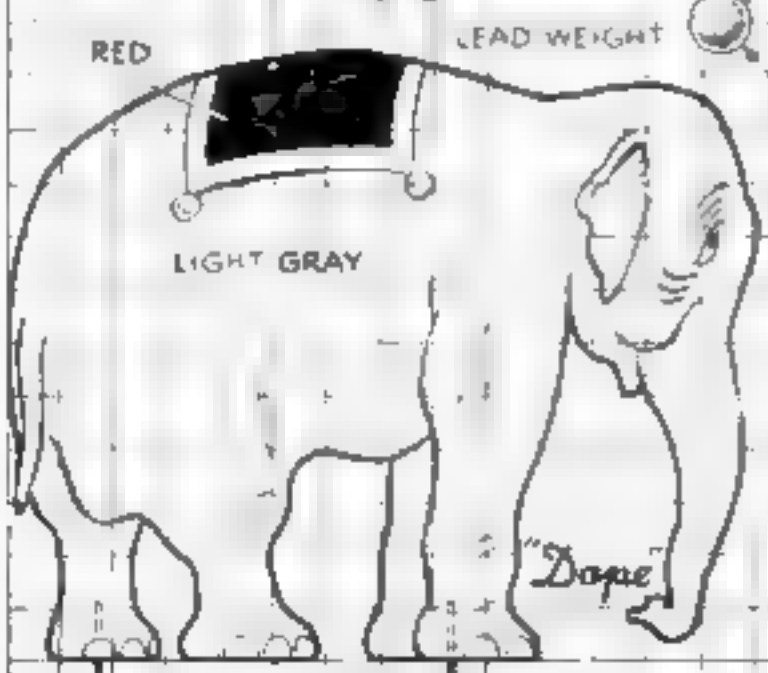
"Dumbo" in Person

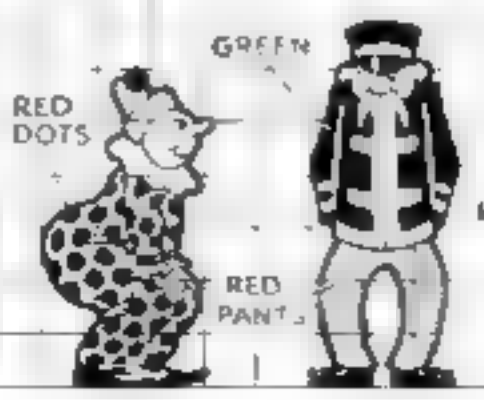


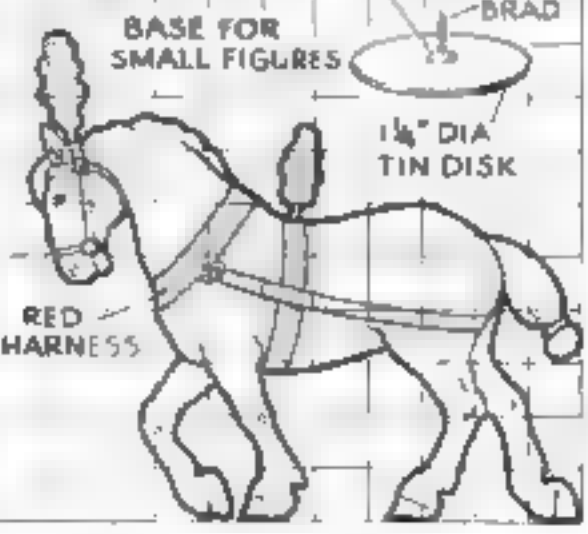
Driver











He Lived in Fourteen Houses

. . . THEN PLANNED A PRIZE-WINNING HOME

James P. Callmer, whose design won fourth prize, is studying at college to be an architect

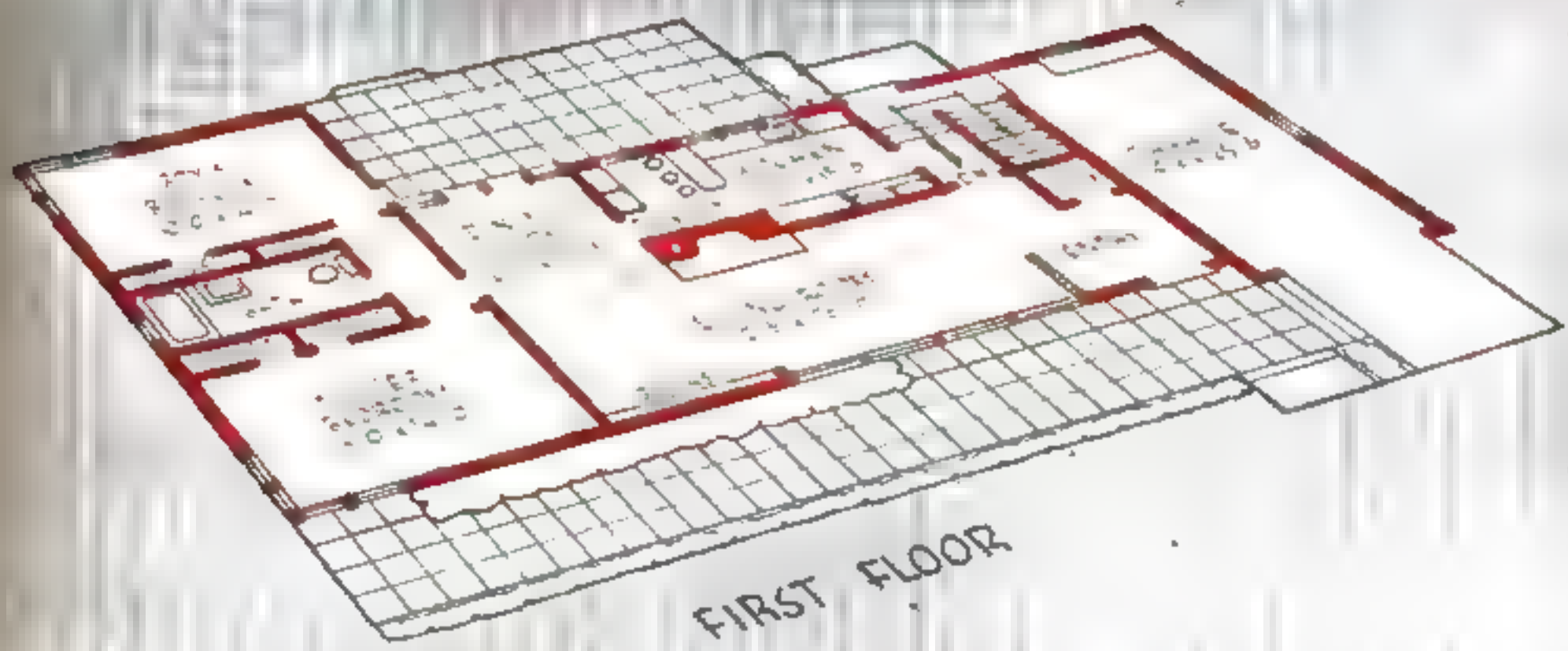
ANYONE who has lived in fourteen different houses should know something about the merits and defects of the average American small home. And that's exactly what 22-year-old James Peter Callmer, fourth-prize winner in our $1,000 house-planning contest, did before he had even finished his high-school course. It may seem an impossibility, but the explanation is a simple one. His father, an Aurora, Ill., carpenter, would build a house and then move into it and live there until it had been sold, whereupon the family would pack and move again.

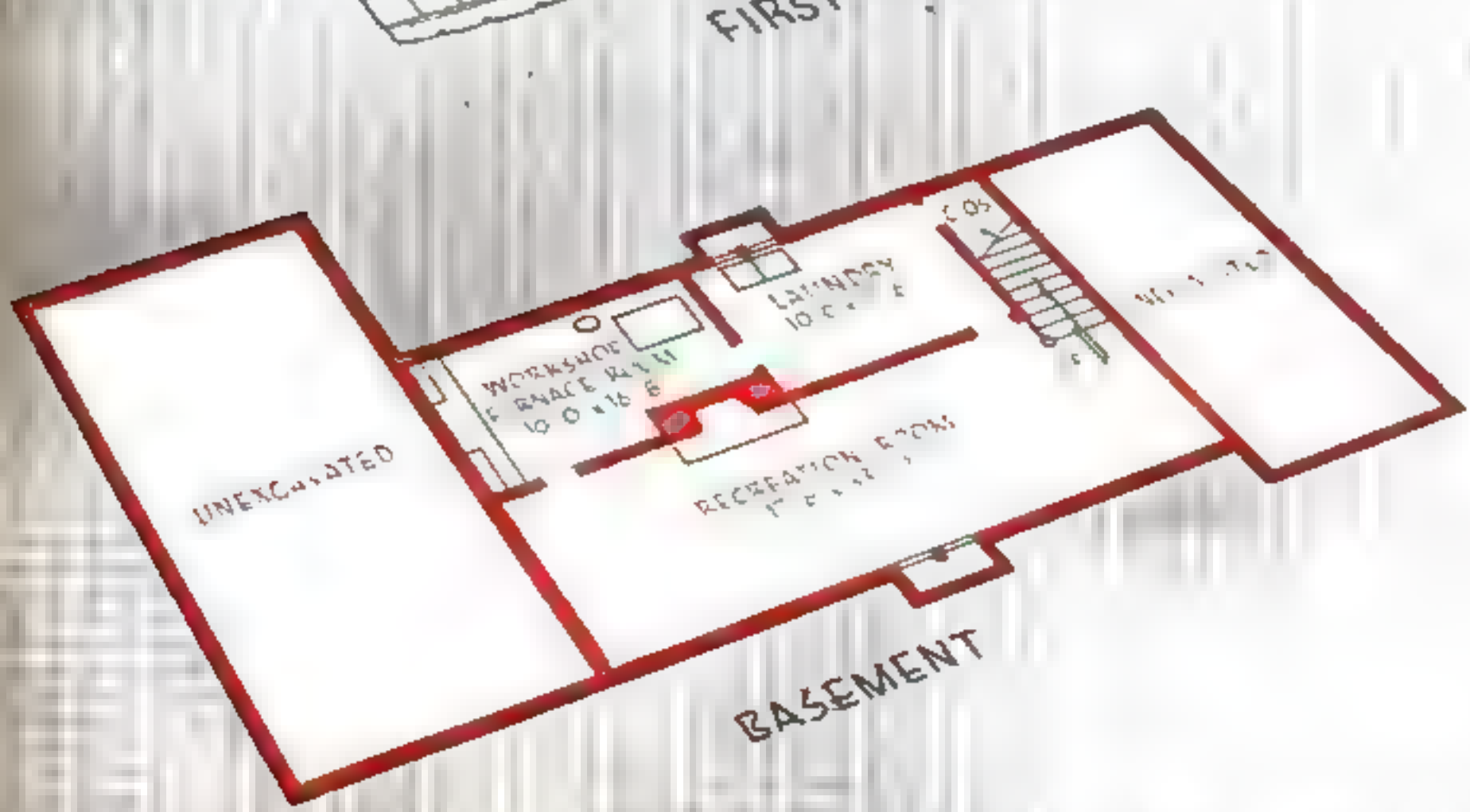
This strange experience, coupled with interest in his father's work, inspired young Callmer with the ambition to become an architect, and he enrolled as a student in a five-year architectural course at the University of Illinois, Urbana, Ill. At the time he entered the POPULAR SCIENCE house contest (see P.S.M., Feb. '41, p. 140, and Oct. '41, p. 138), he was in his fourth year there and awaiting a call to serve in the Army.

Callmer had to do some magical budgeting of his time in order to get his entry ready for the contest. It was necessary to earn part of his college expenses by working in a kitchen and designing decorations for dances; his duties as vice president of the Alpha Chi Rho fraternity also took up time, and his college schedule was heavy. He found, however, that he could do most of the general planning after he had gone to bed. Instead of counting sheep, he visualized room arrangements and house elevations

In his preliminary planning, he paid special attention to saving steps for the woman of the house. The kitchen, he believed, should be as near as practicable to the front door. The living room, dining room, and kitchen were designed first, and the bedrooms, bath, terraces, and garage added. The back terrace was connected with the kitchen in such a way as to serve as a summer dining place. He added a bar in the kitchen for use both as a breakfast bar and a worktable.

After he had made his rough sketches, Callmer did the actual drawing in one day —the final day on which entries could be mailed—and, because of a mix-up, almost didn't get it in. He found that the drugstore post-office substation to which he took the bulky package was closed for the night,


FIRST FLOOR


UNEXCAVATED
WORKSHOP
FURNACE ROOM
LAUNDRY
RECREATION ROOM
BASEMENT

but he persuaded the proprietor to weigh the entry and sell him stamps. Then he went to the main post office, which was also closed, only to find the package would not fit into any of the slots.

In desperation, he flapped the cover of one of the slots until he had attracted the attention of some night post-office workers. The package was accepted and he thought his troubles were over, but the next morning it was back on his desk, marked: "Insufficient postage." However, the postage proved to be correct, and the postmark of the night before had already been stamped on the package, so he got in under the wire.

To supplement his drawings, Callmer submitted the following brief specifications, together with the required statement that he was not a professional architect or an employee of POPULAR SCIENCE.

SPECIFICATIONS

House size—60'x39'
Cubage—22,000 cu. ft.
Cost of house—$7,700
Plot size—75'x125'
Cost of plot—$500
Size of family—Two adults, two boys
Income—$2,500 per year

CONSTRUCTION

Foundation. Footings: continuous-poured concrete. Waterproofing: tar felt, all walls and floor.

Structure. Exterior walls: 2"x4" studs, 1"x12" vertical redwood boards, building paper, 1"x6" yellow-pine sheathing. Interior: ¼" plywood. Floor: wood joists, subflooring (shiplap laid diagonally).

Roof. 2"x6" yellow-pine rafters, 1"x4" nailing strips, wood shingles. Deck over garage: wood ceiling joists and roof rafters. Finish: metal.

Chimney. Common brick, terra-cotta flue lining, patent throat damper.

Sheet metal. Flashing, gutters, and leaders: galvanized iron. Garage roof: copper.

Insulation. Rock wool between rafters and studs.

Windows. Sash: wood, white-pine casement. Frame: redwood sills, white-pine jambs and heads. Glass: grade B, single strength.

Stairs. Pine treads and risers.

Floors. Living room, bedrooms, and halls: ½"x2" white oak, second grade. Bathroom: tile, mat glaze. Kitchen: pine, covered with linoleum. Terraces: common brick laid in 2" bed of sand.

Wall coverings. Natural waxed plywood. Kitchen and bath: plaster and paint.

Woodwork. Trim and cabinets: white pine.

Hardware. Interior and exterior: hammered black iron.

Electrical installation. Wiring system: BX. Switches: toggle.

Kitchen equipment. Stove: Westinghouse. Refrigerator: Kelvinator. Sink: Crane. Cabinet: to be built to detail.

Laundry equipment. Sink: two-compartment laundry tray. Washing machine: Thor washer and mangle.

Bathroom equipment. Lavatory, built-in tub, and toilet: Crane.

Plumbing. Pipes: wrought iron.

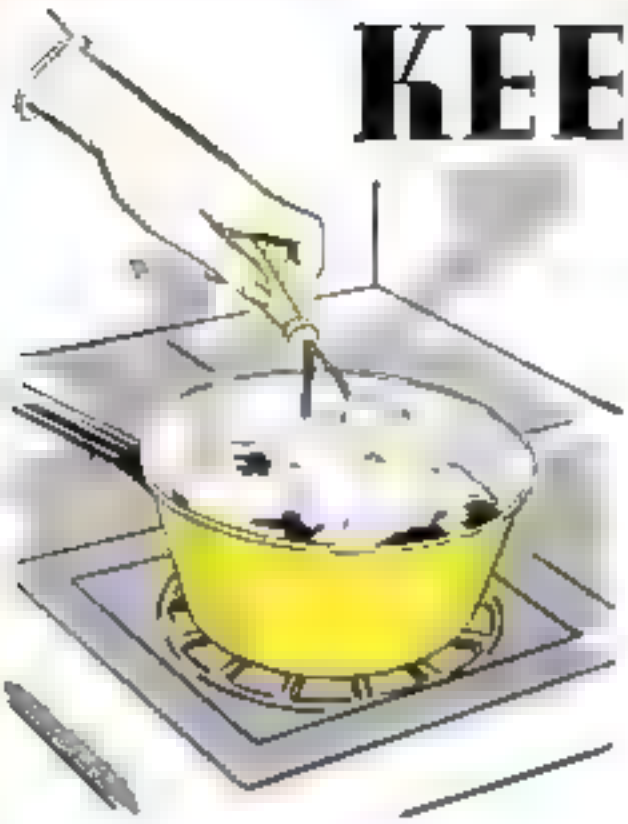
Heating. Gravity warm-air system with ducts. Water heater.

Special equipment. Radio outlets in living room and game room.

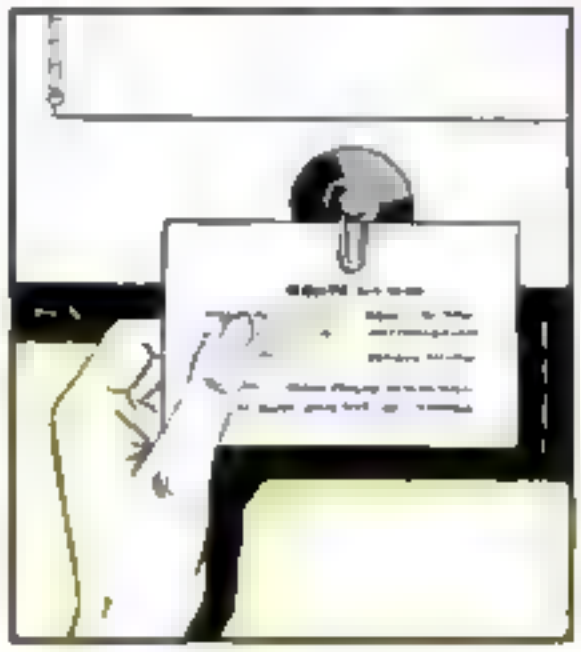
Young Callmer finds relaxation at his fraternity house with two of his fraternity brothers at the University of Illinois. Callmer is in the center

Time for planning a prize-winning home had to be budgeted, most of the preliminary work being done at night. The final drawing was made in one day

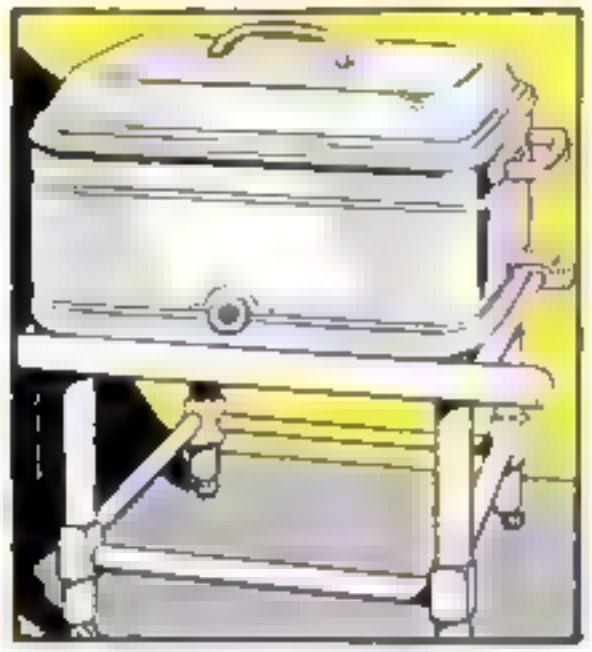
KEEPING THE HOME



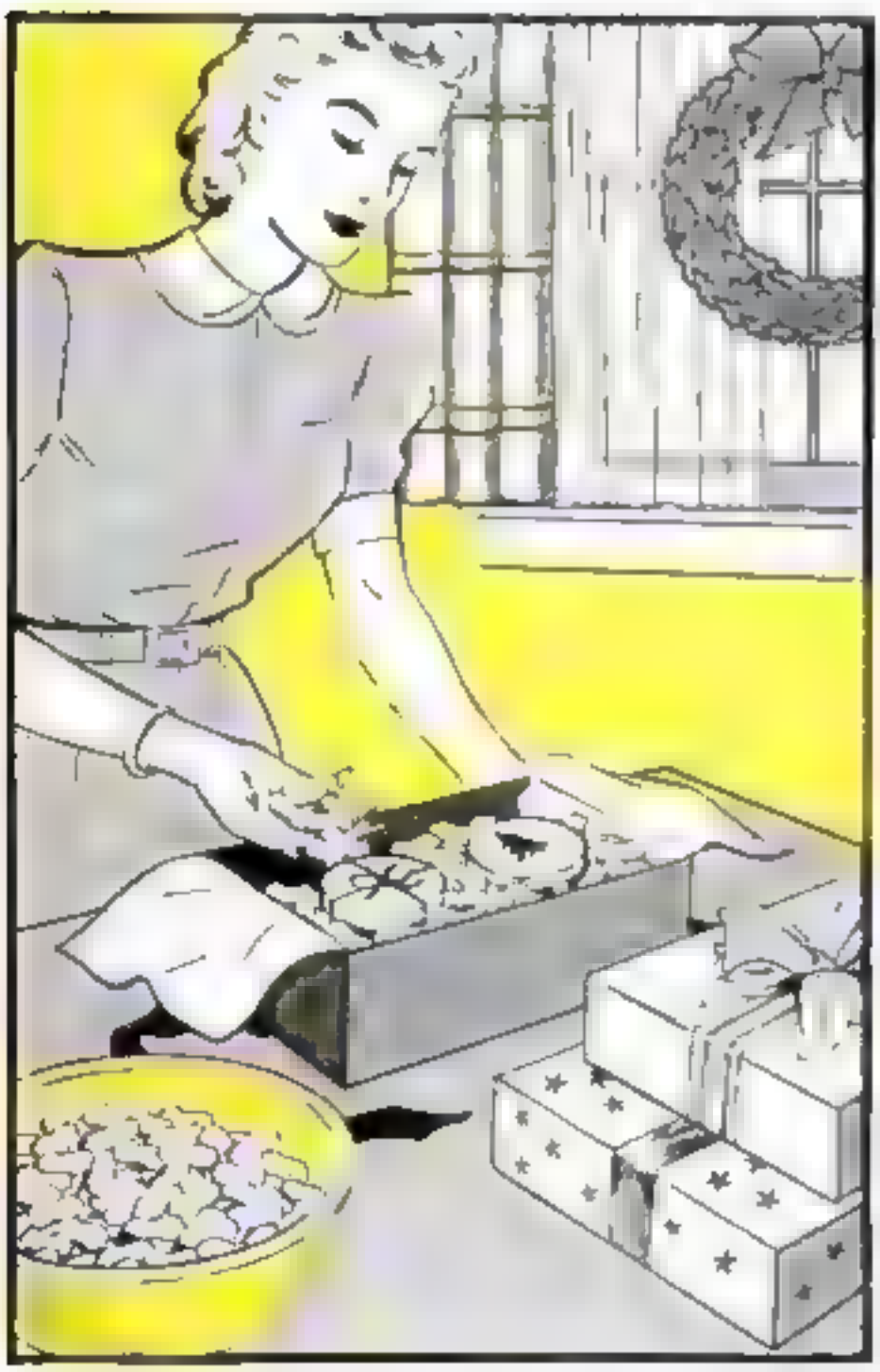
When a spoon is used to skim jelly, the froth usually floats about just out of reach. A new vegetable brush does the job in record time. Froth adheres readily to the bristles, but is easily washed off with hot water



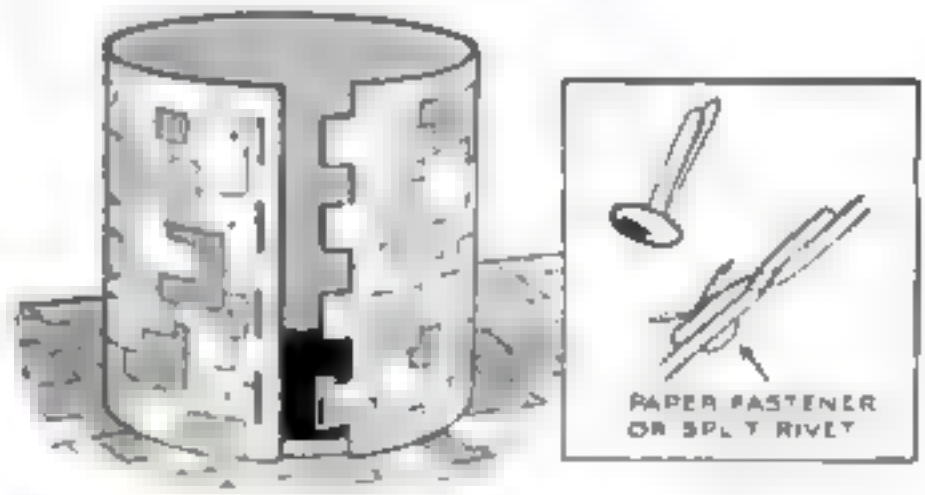
To keep a recipe card in sight when cooking, use a paper clip fastened to a suction cup. Attach this to a wall or cupboard door. A little glycerin on the rubber will make it hold firmly



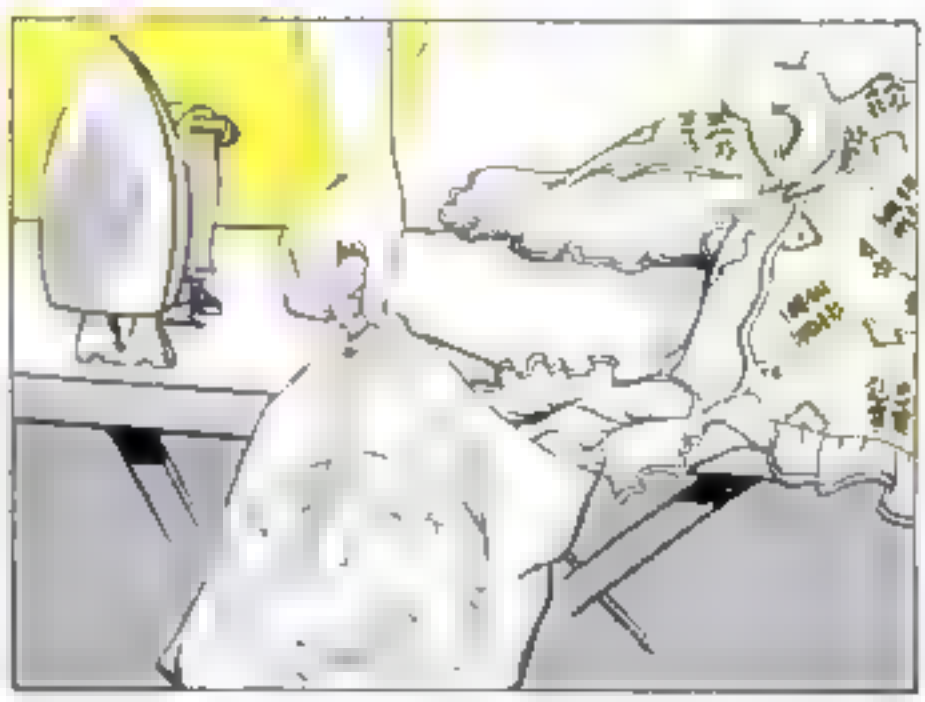
An inexpensive luggage rack such as used in hotel rooms makes an excellent portable stand for an electric roaster. Fit rubber-tired or ordinary casters to the legs



Pack your gifts with peanuts! They prevent small articles from rattling, but add little weight to the package and, of course, can finally be eaten



A wastebasket to match a linoleum floor is made from a scrap of the linoleum and the top of a broken stool. Insert tabs so that they are inside. Tack at the bottom, and tape the top edge



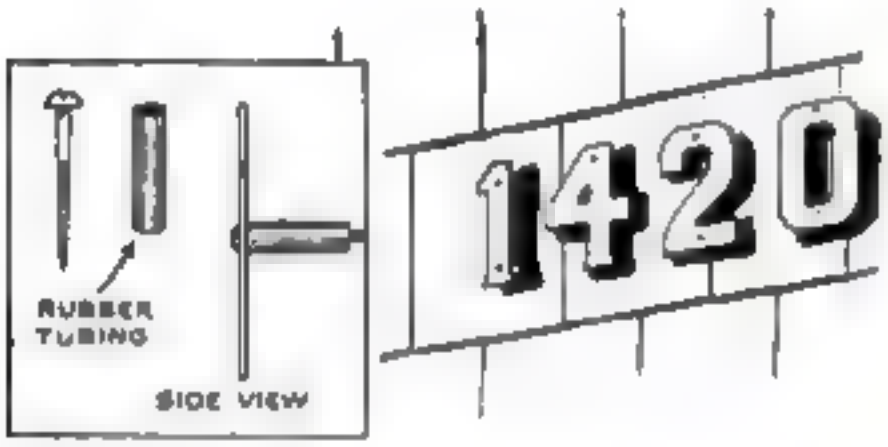
To keep one part of a double curtain clean and moist while ironing the other, put it in a wet flour or sugar sack pinned to the ironing board

SHIPSHAPE

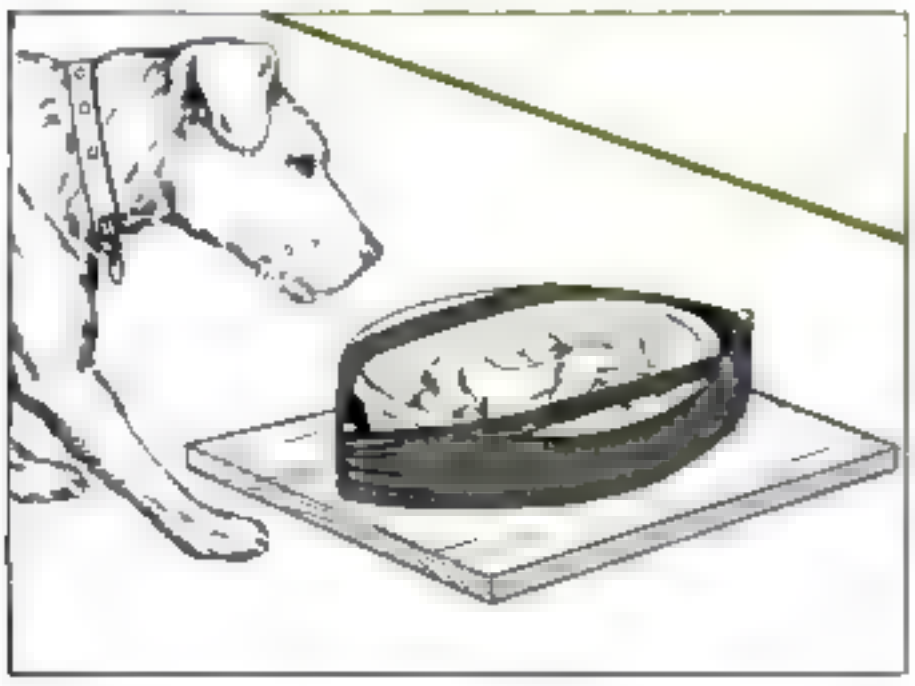
Coat hangers cannot slide about if hung from a piece of heavily galvanized chain inserted in the clothesline. Garments so suspended stay separated, hence dry faster

When painting wood, it is often necessary to seal knots and sap pockets with shellac. A mucilage bottle makes a handy container and applicator for this purpose

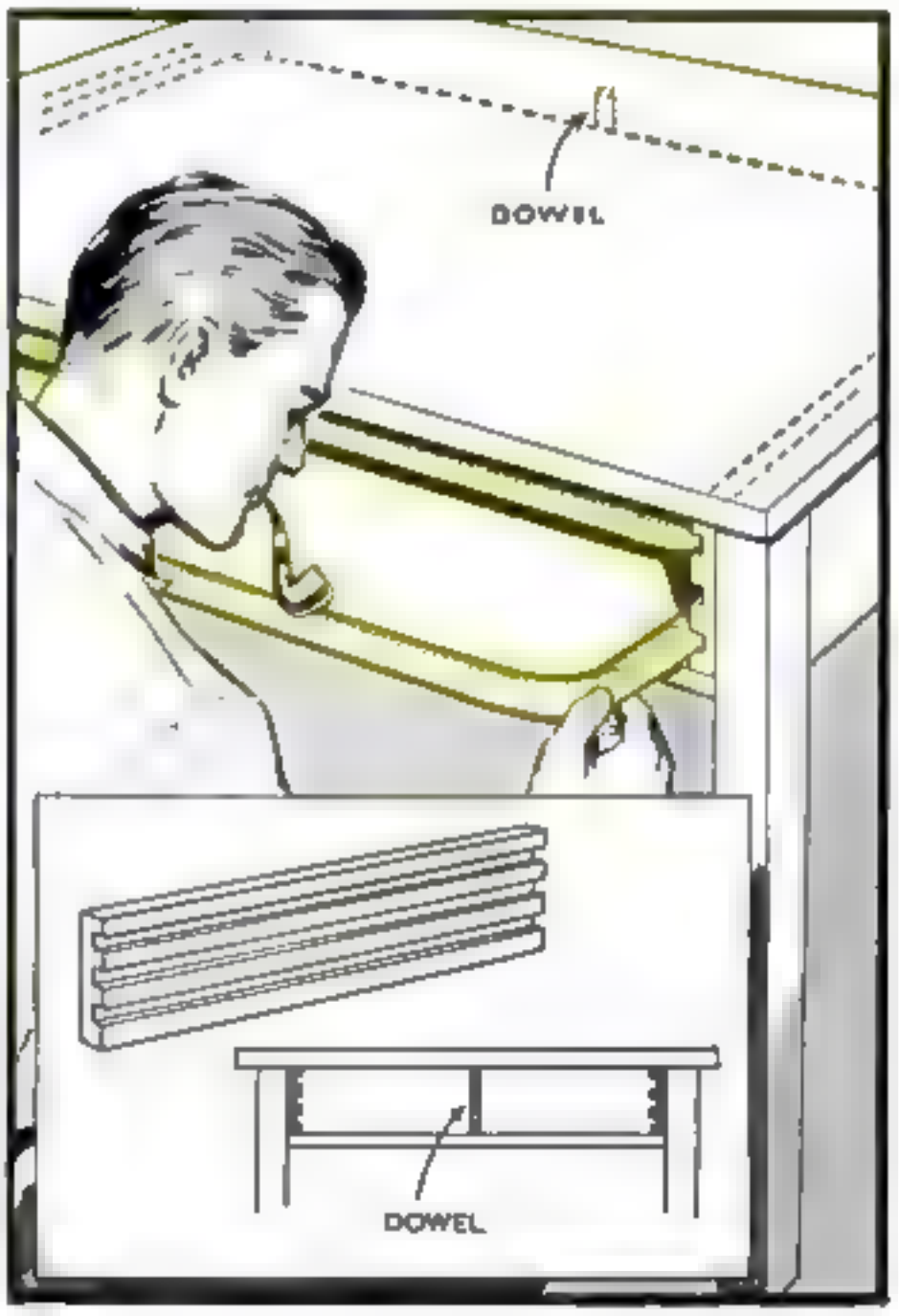
Old mirrors can sometimes be saved by scraping off the flaked silver to form attractive designs or silhouettes. Apply black or aluminum paint, then back with black enamel



Metal house numbers mounted with 1½" lengths of windshield-wiper tubing as above, display a novel shadow effect and will not cause corrosion stains as they do when nailed to the wall



If your dog's feed pan slides about as he eats, try fastening it down to a heavy board with two nails and a strip of inner tube with two slits



Unused drawer space in a kitchen table can be used for storing big trays. On a circular saw, cut two grooved guides to fit the table and allow the trays to slide freely. Fasten these inside the legs, and paint them to match. A dowel glued into table top and rear rail keeps trays from sliding in too far

The operation was a success! Left and above, same kitchen before and after. The cabinet conceals a washing machine

Face Lifting

By J. E. BULLARD

ONE of the most satisfying projects the handy man can undertake is home modernization. At a comparatively low cost for materials a room can often be brought up-to-date and the entire house thereby made more livable. The accompanying photographs show how one wall of an outmoded kitchen was remodeled. The old sink and laundry tubs were discarded in favor of a modern sink and a washing machine. These were housed in a cabinet that provides a great deal of storage room as well as useful working space on its counter top.

The ends, floor, top and doors are all of ¾" plywood. Although linoleum will do for counter covering, in this instance black pressed composition board, ⅛" thick, was used. The same material covers the wall for about 17" above the counter top.

It was necessary to install the washing machine so that it might be removed for servicing if necessary. The left end of the cabinet and that portion of the front covering the machine were built as a unit, which is held in place by two bolts and one screw. By removing these, the entire left end can be slid away.

The first step in constructing the cabinet is to mark out on the floor the outline of the base as shown in the construction drawings on one of the following pages. Set 1" by 4" strips on edge along the lines, and carefully scribe and plane them to fit any irregularities of the floor so that the upper edges will lie in one level plane. These fitted pieces, with the exception of those be-

At left, blocks screwed to the doors hold large frying pans. There is ample room in the sliding bin for lids and lighter utensils. Two drawers above it hold table silver and cooking gadgets

Above, working drawings for the sliding bin. The runners can be ripped from an old table leaf such as can be found in most attics. Use screws instead of nails for greater rigidity

for the Kitchen Sink

longing to the detachable compartment, are then nailed to battens, which are themselves nailed or screwed to the floor. Nail cross battens where the supporting posts for the sink are to be placed, and fasten another to the baseboard with wood screws so that its upper edge is level with the top of the 1" by 4" strips.

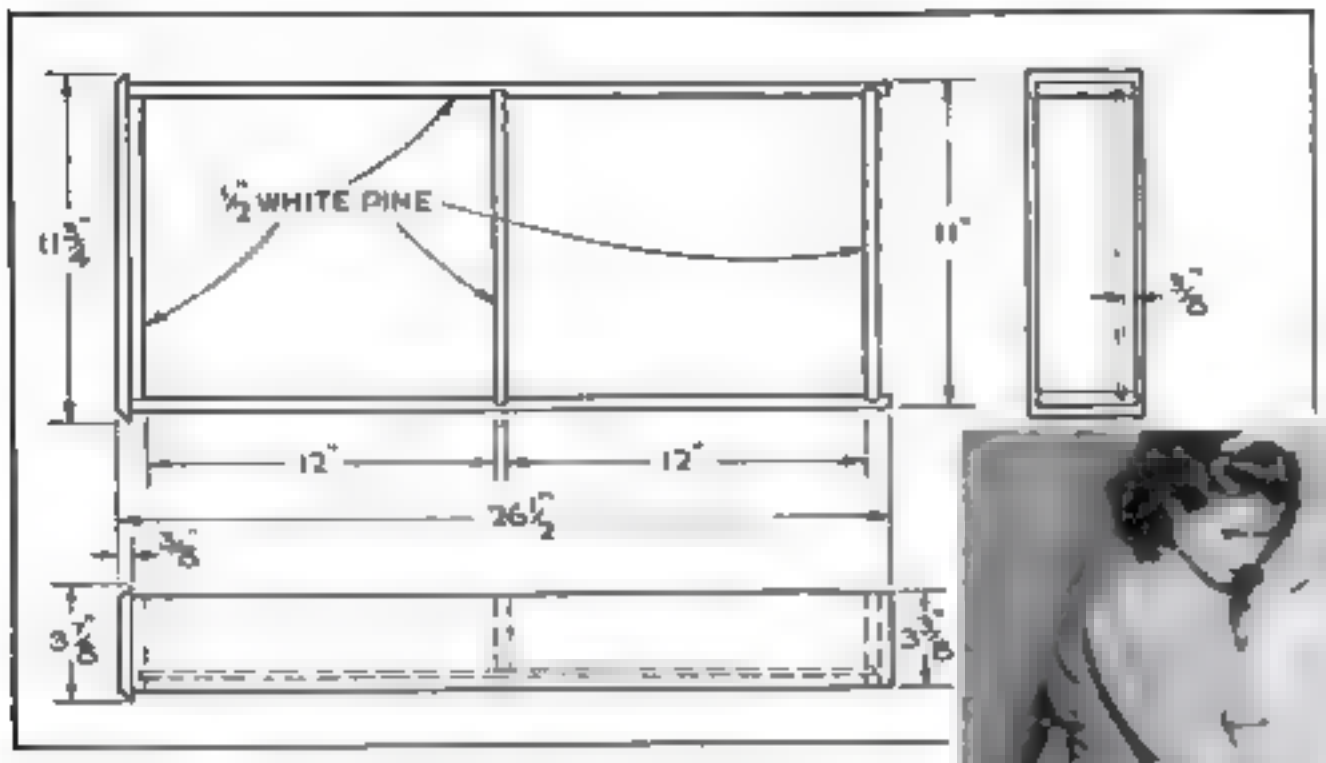
Upon this foundation is nailed a 26" by 71" floor of ¾" plywood, which overhangs about 3" at the front and right side to provide a toe space. This cabinet bottom is not carried into the washing-machine compartment; the machine rests directly on the floor of the room.

The front uprights between the doors and at each end are 1" by 3¾" by 27". They are nailed in front of the cabinet floor, and ¾" by ¾" strips are fitted between them to form a flush surface for the doors. These uprights can be nailed to the 2" by 2" sink supports, which are in turn fastened to the floor with small iron brackets. The sink framework, of 1" by 5¼" pieces, is screwed to these supports and to similar ones at the back.

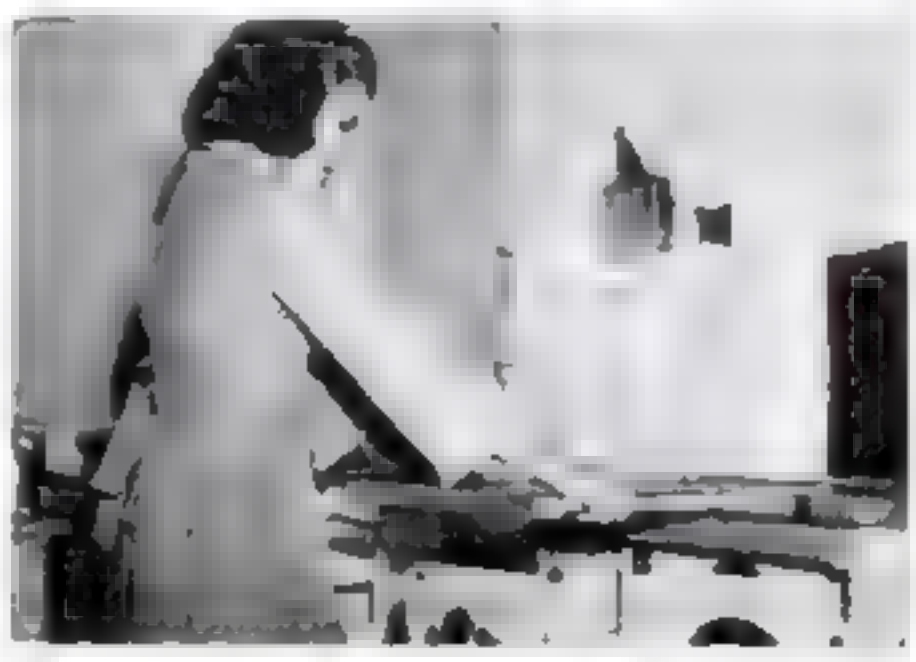
A 1" by 5¼" apron extends across the tops of three front uprights and flush with them. This can be nailed to the sink supports. Across the washing-machine compartment this apron takes the form of a sliding panel fitted with dummy drawer fronts. The drawer fronts under the sink also are for the sake of appearance only. At the right end, openings are cut for two real drawers, and a sliding bin is fitted beneath them.

The counter top, also of ¾" plywood, overhangs the front by 1". A hole is cut in it for the sink, and its edges are rabbeted to bring the sink rim flush with the top surface. This can be done with a rabbeting plane and a chisel.

In making the original, a coating of casein glue was applied to the plywood top, the angle molding was slipped on the back edge of the ⅛" thick composition board, and this was weighted in place with sandbags. The



At left, how the drawers are made. Left-over composition board will do for the drawer bottoms. Below, how the dummy drawer front slides out to the left so that the top can be opened



Directly above, pulling out a section of the top so that the washing machine can be reached from above. Details of the sliding top and panel are shown in the drawing at bottom of the facing page

L-shaped molding was nailed to the wall, glue was applied to the latter, and another board was pressed against it by means of pieces of wood braced against the opposite wall, until the glue had set.

The outer-edge molding was fastened to the top with screws, but that on the inner edge of the sink opening could not be secured in this way to the thin composition board. Instead, the ends of the nailing-strip portion of each piece were cut to shape as shown in the drawings, the short pieces glued to the board, and the long ones slipped into place with the cut-out lugs bent down. These lugs were then bent back behind the short pieces to lock the molding firmly.

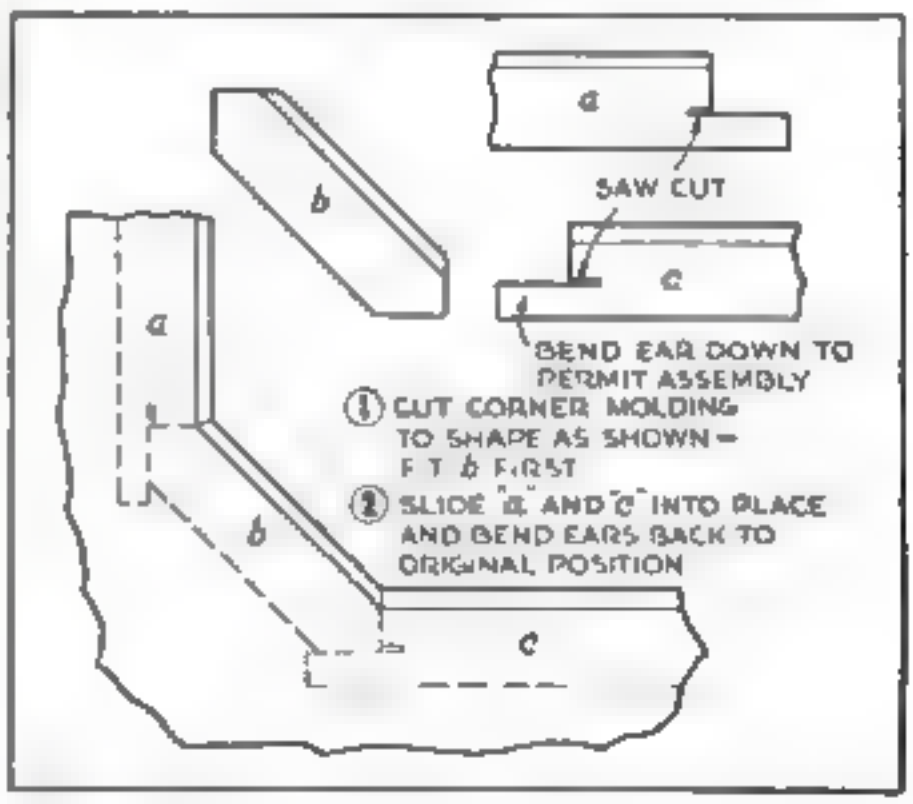
All doors can be cut from ¾" plywood. They are rabbeted at top, sides, and bottom, and at the meeting edges. Bevel the three outer edges of each door 60 deg.

Any edge defects in the plywood are filled with plastic composition wood. A final sandpapering produces a smooth surface.

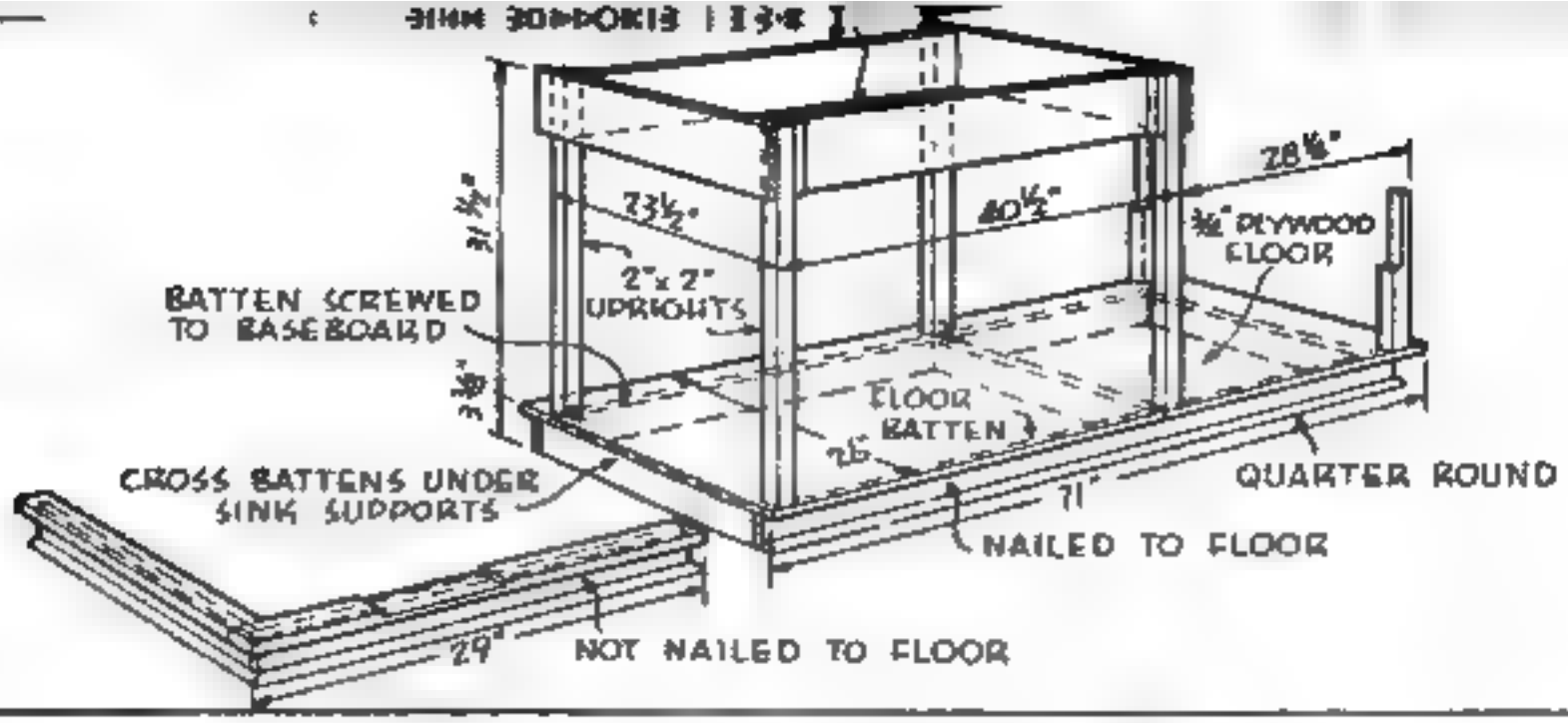
Knife racks were fastened to the insides of the doors on the washing-machine compartment, as well as a small rack for a few tools commonly used about the house. To the inside of the doors at the right end are screwed blocks that hold two large frying pans.

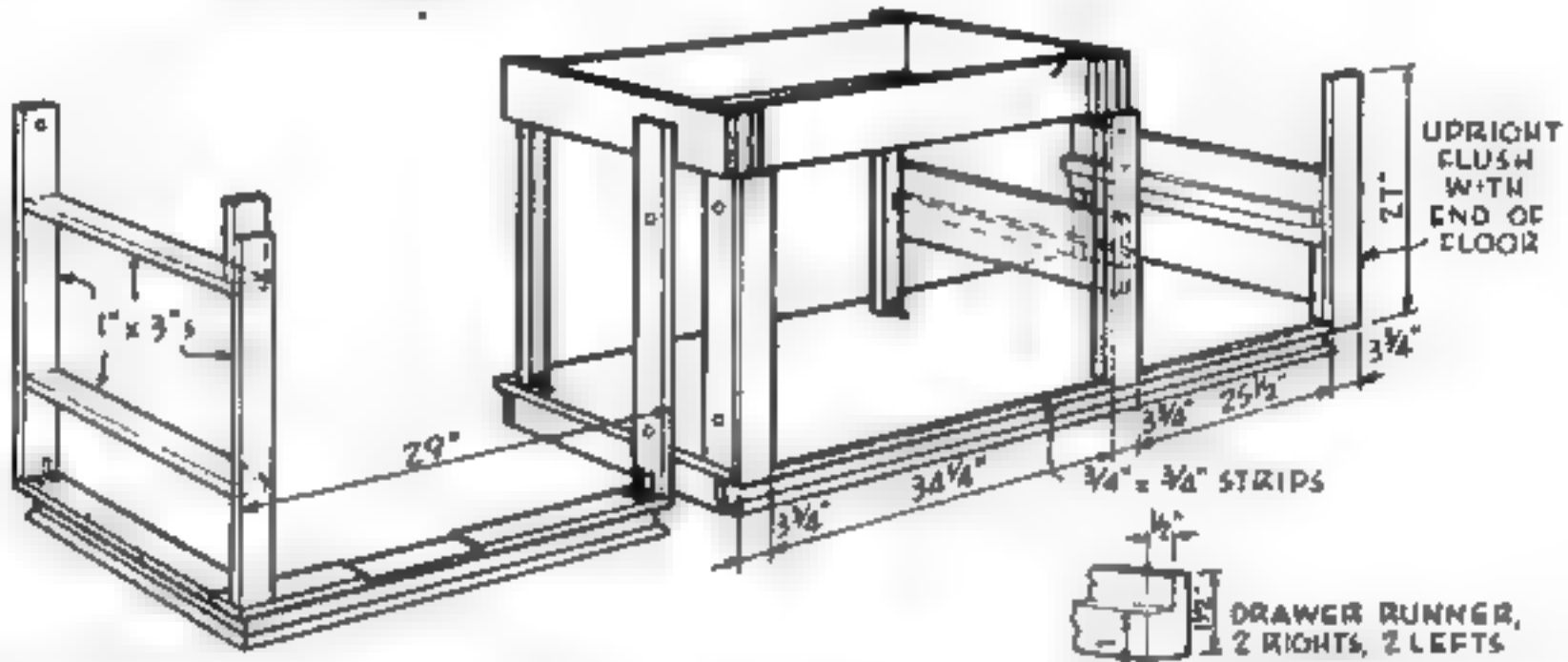
One door under the sink is fitted with wooden brackets to hold a wire drain basket. The other has a rack for soap powder and cans of kitchen cleanser. Fastened to the framework supporting the sink is a sheet-metal box in which a soap dish, pot cleaner, and a small scrubbing brush may be kept.

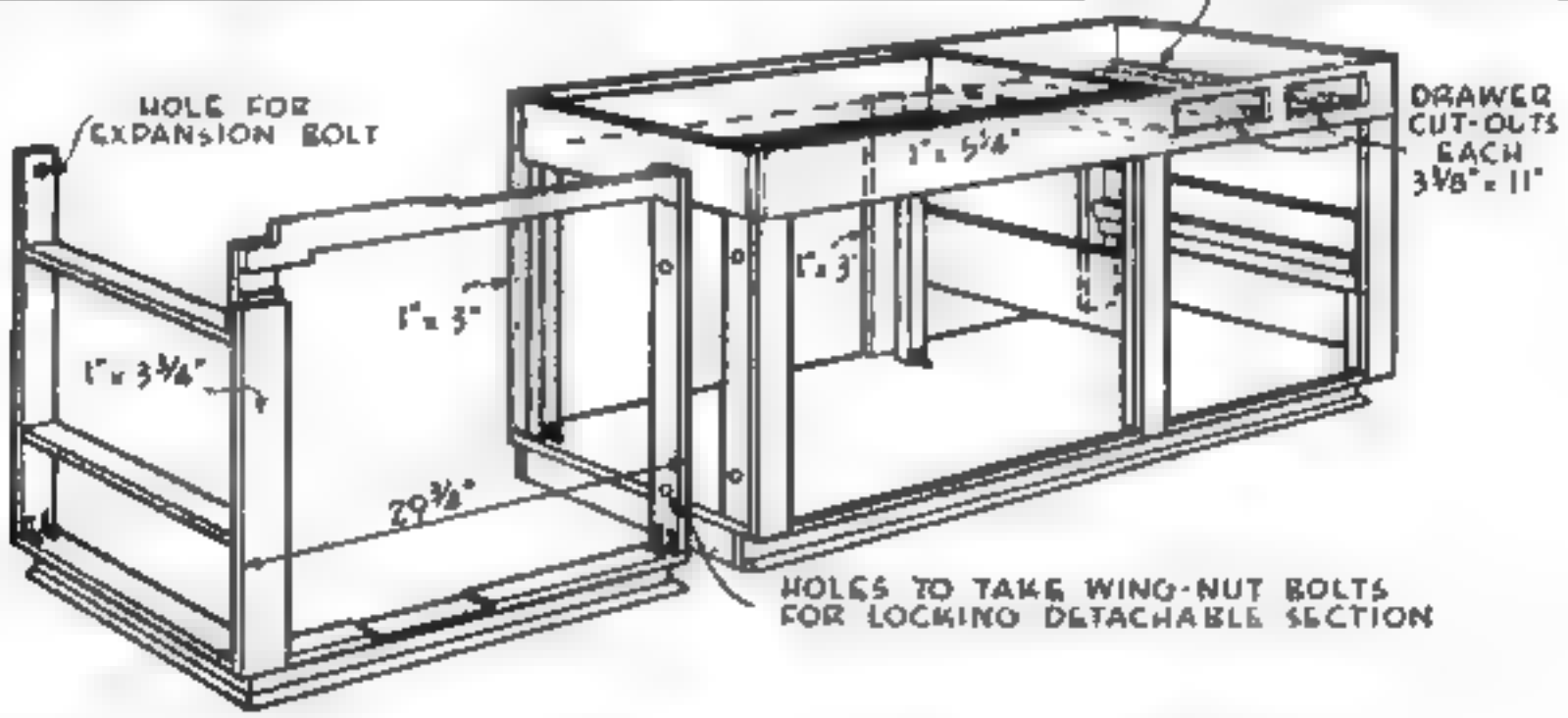
Both the drawer bottoms and some parts of the knife racks can be made of left-over pieces of composition board. Drawer fronts and runners for the cabinet shown were ripped from old table extension leaves such as can be found in most attics. The cost of all building materials, including lumber, molding, hardware, and incidental supplies, but not the sink, was less than fifty dollars.

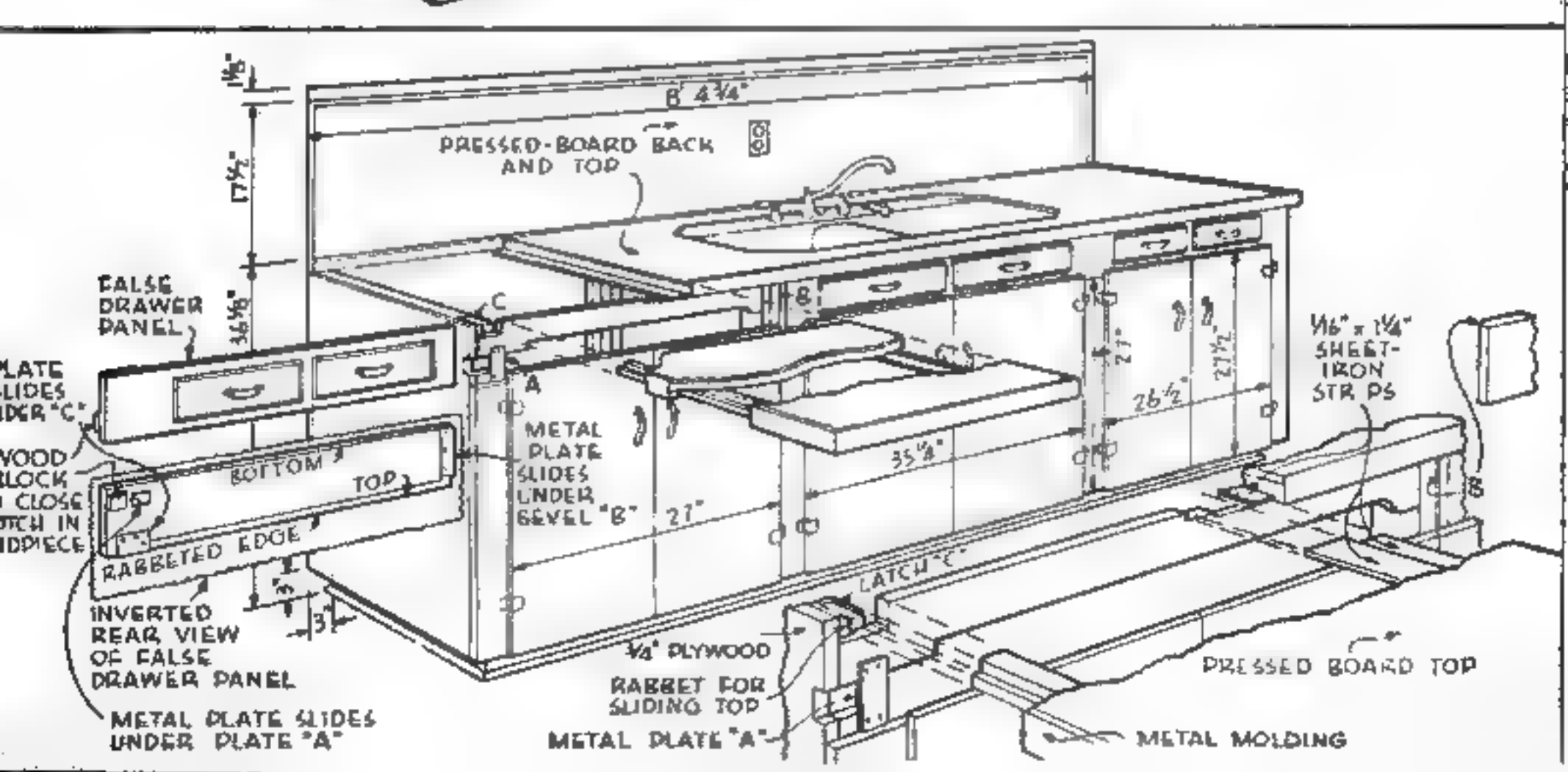


How molding is fastened to sink opening without screws. The short corner pieces are fitted first

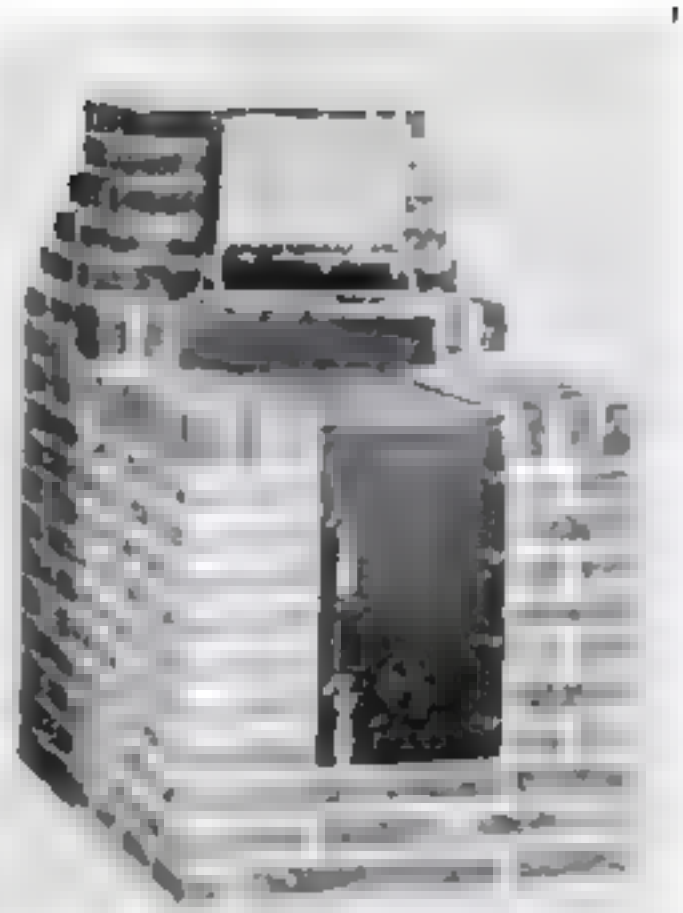

BATTEN SCREWED TO BASEBOARD
2"x 2" UPRIGHTS
23½"
40½"
28½"
¾" PLYWOOD FLOOR
FLOOR BATTEN
26"
71"
QUARTER ROUND
CROSS BATTENS UNDER SINK SUPPORTS
29"
NOT NAILED TO FLOOR
NAILED TO FLOOR


1"x 3"s
29"
UPRIGHT FLUSH WITH END OF FLOOR
27"
3¼"
3⅛"
25½"
3¼"
34¼"
¾"x ¾" STRIPS
½"
DRAWER RUNNER, 2 RIGHTS, 2 LEFTS


HOLE FOR EXPANSION BOLT
1"x 5¼"
DRAWER CUT-OUTS EACH 3⅛"x 11"
1"x 3"
1"x 3¾"
29⅜"
HOLES TO TAKE WING-NUT BOLTS FOR LOCKING DETACHABLE SECTION


B 4¾"
PRESSED-BOARD BACK AND TOP
FALSE DRAWER PANEL
C
B
A
METAL PLATE SLIDES UNDER LEVEL "B"
27"
35¼"
26½"
27"
27½"
1/16"x 1¼" SHEET-IRON STRIPS
BOTTOM
TOP
RABBETED EDGE
INVERTED REAR VIEW OF FALSE DRAWER PANEL
METAL PLATE SLIDES UNDER PLATE "A"
¼" PLYWOOD
RABBET FOR SLIDING TOP
METAL PLATE "A"
LATCH "C"
PRESSED BOARD TOP
METAL MOLDING

IDEAS for HOME OWNERS



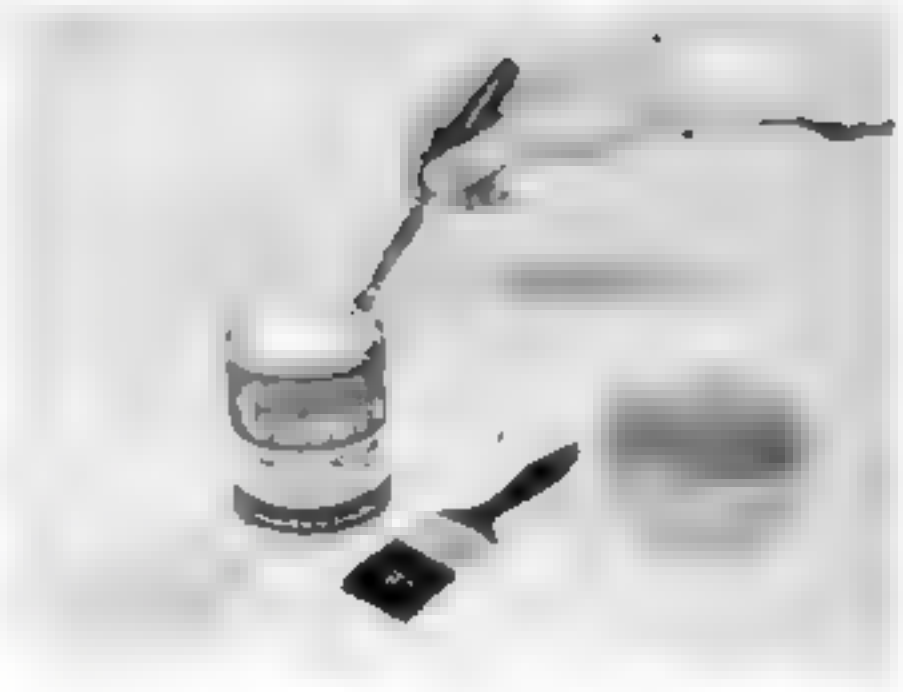
FIREPLACE UNITS FOR OUTDOORS can be obtained ready built, at reasonable cost, with a steel superstructure, heavy bar-type top, and solid oven and grate doors. The grate is adjustable in height for charcoal or other fuel. An accessory unit, the vertical grate shown in front of the low chimney, is for steaks. Three sacks of mortar, 20 fire bricks, and 319 face bricks are needed to complete the job, but a 6′ chimney will require the use of 81 more face bricks.

SWIVEL ELECTRIC LIGHT SOCKETS (at right) can be turned to a 90-deg. angle with the base and rotated in a complete circle. Their special design prevents twisting of the connecting wires inside, and a spring tension compensates for wear and keeps the socket fixed at any angle. Several styles are available, with or without extension tubing.

VENTILATION FOR KITCHEN OR BATH can be included in new construction plans or easily installed in homes already built, the chief requirement being an air duct and a space 12" by 20" and 4½" deep between ceiling joists for a motor and blower hidden behind a polished or enameled grille. Draftproof shutters at each end of the duct are designed to open and close as the turbine blower is started or stopped. Operation of the unit is controlled by a wall switch.

Grille blower, and motor of this ventilator are easy to remove. Cleaning may be needed once a year, oiling about once in two years

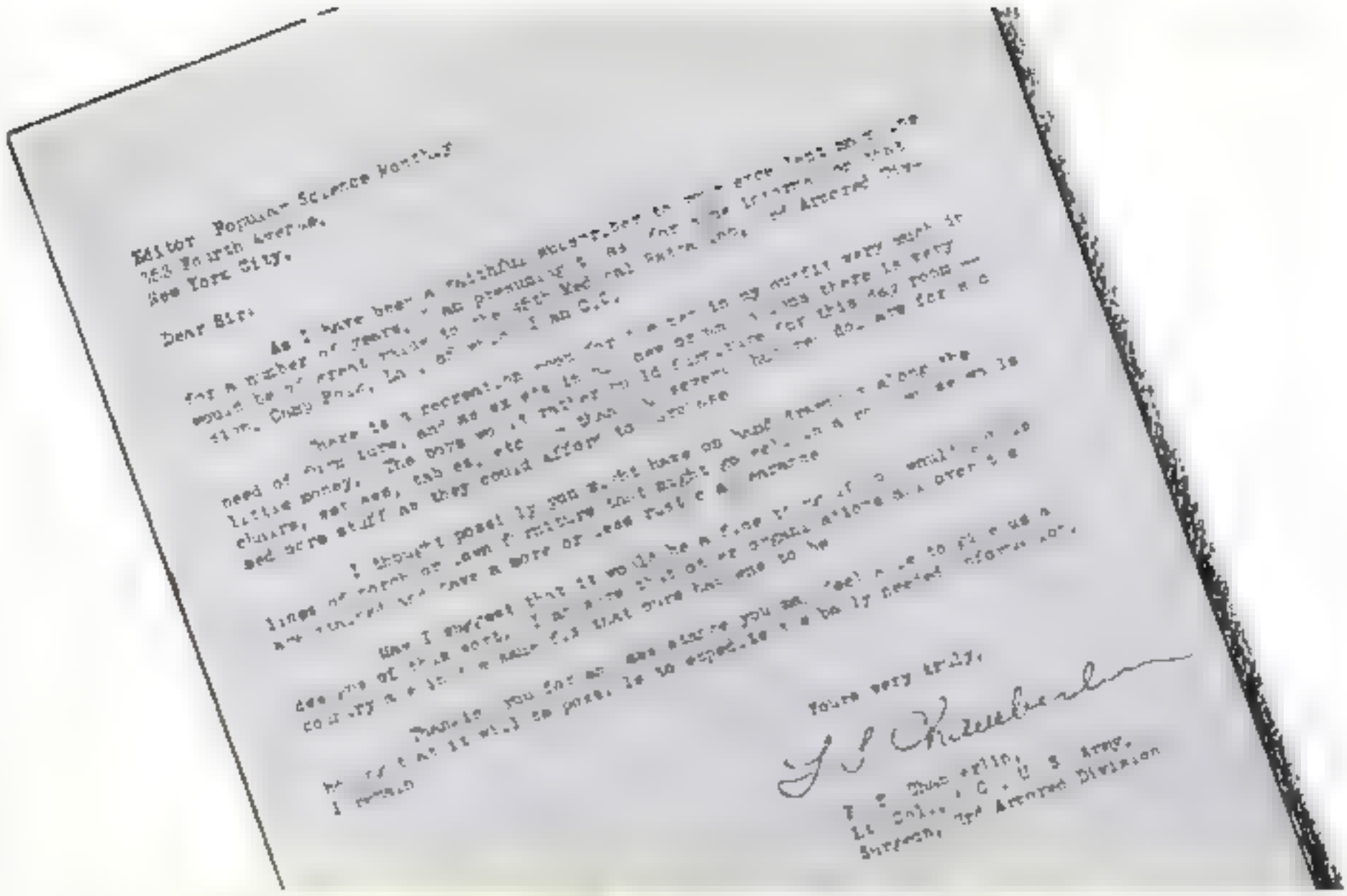
QUICK-DRYING SOY-BEAN PAINT, which uses water as a thinner, is available for application over plastered walls or wall paper without sizing. The paint comes in the form of a paste and is mixed with water in the ratio of a half gallon of water to each gallon of paste. Its soy-bean protein binder is said to give it additional adhesive qualities and to eliminate the odors sometimes associated with other water colors. Drying is so rapid, according to the makers, that a room painted one day can be put in use the next, and one coat is often all that is necessary. The paste is made in a variety of decorator's colors.



THREE-WAY PLUGS WITH BUILT-IN FUSES give added protection to the small motors in such constant use throughout the home and in the home workshop, and prevent the cutting out of an entire circuit each time a short occurs. The plugs themselves are constructed of a hard-rubber compound which is difficult to damage or crack. The prongs with which they are fitted are of the twist-to-lock type—once the plug is inserted in the socket, a slight twist to the right will automatically lock it in place.

FINISHED HARDWOOD FLOORING, ⅛" thick, can be laid directly over an old floor, or on subfloors or concrete, the boards being cemented to the base with an adhesive applied to the felt backing of the sections and to the old floor. When this has dried, the new flooring is laid in position and firmly tapped with a rubber mallet. The thickness added to the old floor being only about ⅛", the necessity of changing baseboards, door casings, or radiators is eliminated. The flooring comes in several designs and woods—tile, random-width planks, and basket-weave, and light or dark white oak, walnut, and teak. The tile sections are 9" by 9", and the basket-weave 12" by 12". The floor sections are machine sanded at the factory, sealed with tung oil, burnished with steel wool, filled with a silex filler and hand rubbed, and polished to a hard-wax surface for resistance to wear, abrasion, scuffing, and denting.

Laying hardwood floor planking on a concrete base. Above, the adhesive is applied to the old floor, and, below, after it has dried, a board is laid and tapped firmly with a rubber mallet



Here's Your Answer,

By JOSEPH ARONSON

Noted interior decorator and author of The Book of Furniture and Decoration and The Encyclopedia of Furniture

SOUNDLY engineered, easily constructed furniture is the order of the day in Army-camp recreation rooms. The designs illustrated on these and the following pages can be made by amateur carpenters with hand tools and common materials such as 2 by 4's, plywood panels, and surfaced boards of standard thickness.

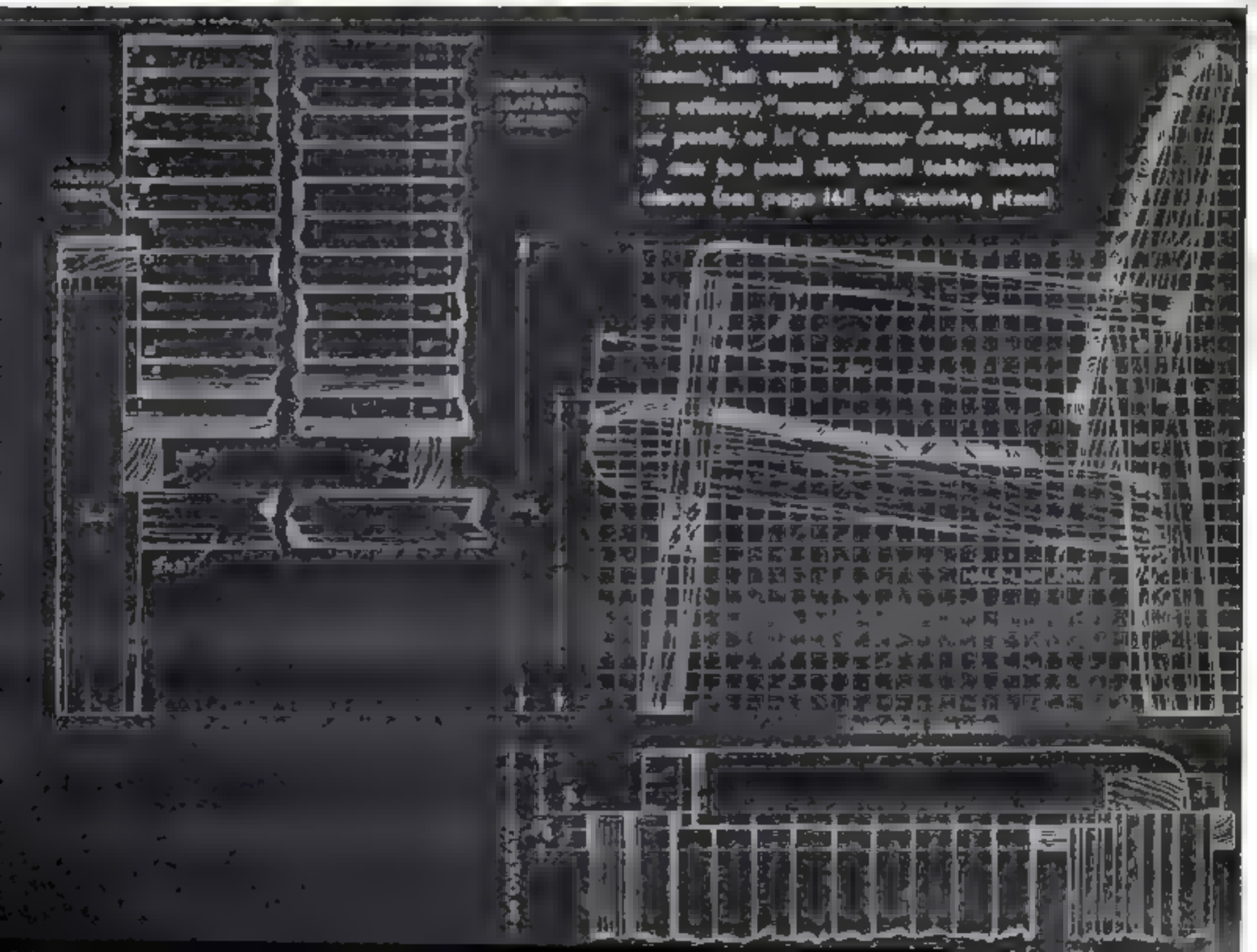
So simple and serviceable are these pieces that they will withstand more than ordinary usage. They are quite suitable, too, as extra furniture for a beach or lake cottage, mountain cabin, or hunting lodge, and could be built on the spot, if necessary, from whatever materials are locally available.

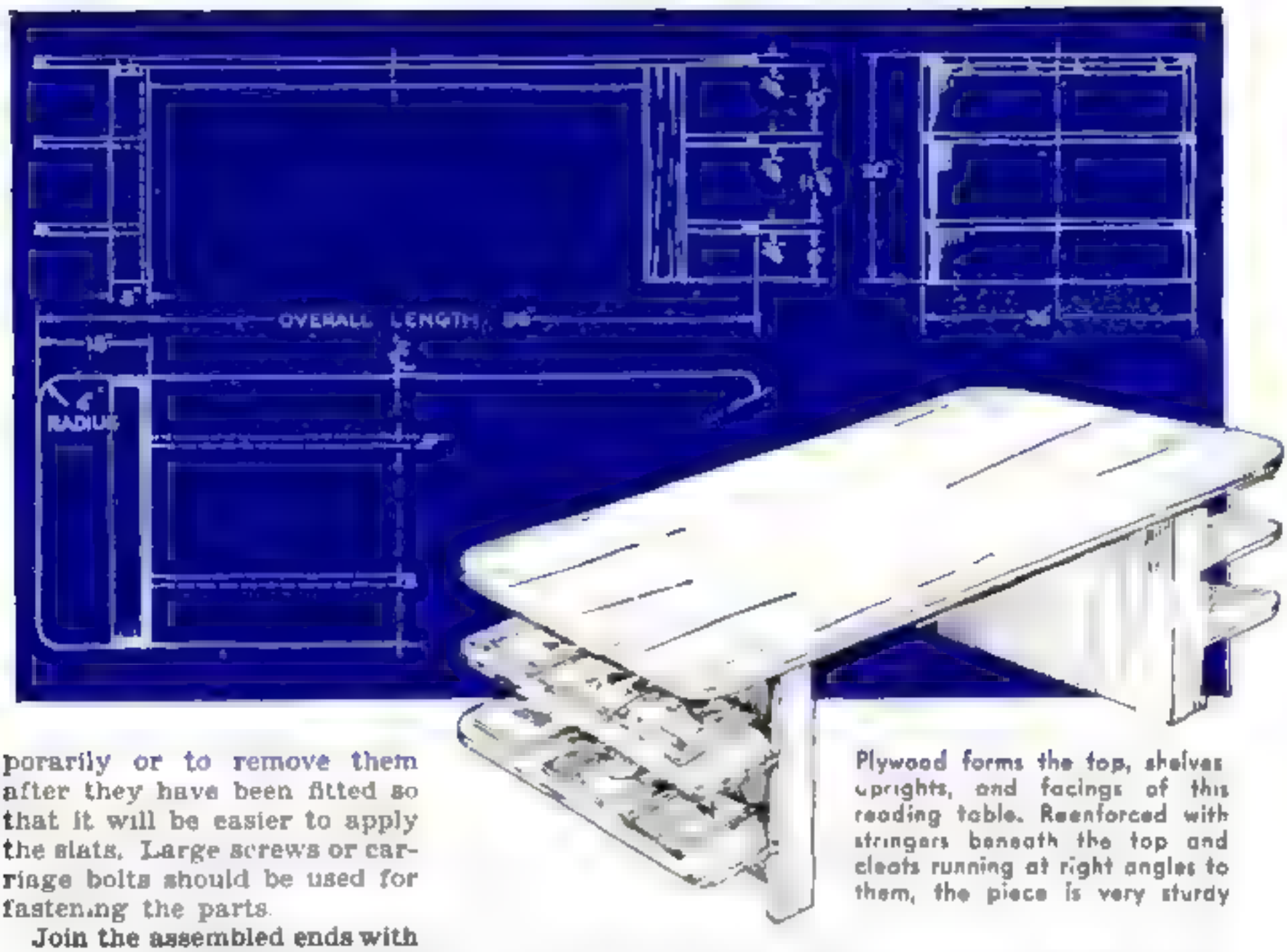
Settee. This can be made 84" or 50" in length, or reduced to 28", if desired, in which case it becomes an armchair. If upholstering talent is available, loose pad cushions, like the familiar beach roll, may be made for the seat, which then will almost pass as a sofa. The framework is made mainly from dressed "two by fours," which are about 1¾" by 3¾" finished size (see the list of materials on page 165).

First, saw two seat bases and two back supports to the shapes shown in the end view. The squares may be used for drawing full-size patterns of these parts. Join each pair with an end-lap joint—that is, notch each piece halfway into the other. Then make the two front legs. Note that a flat side of these faces toward the front. Lay one seat base over one of the legs at the correct angle and mark it so that it can be notched ¾" deep to receive the base. Notch the other leg to make a pair. Make two back legs, but note that they are used with a narrow edge facing the front. Two arms should now be made, and these are notched ¾" deep at the rear end to fit the back supports.

Assemble the two end frames. It is just as well, however, to leave off the arms tem-

Colonel Chamberlin





Plywood forms the top, shelves uprights, and facings of this reading table. Reenforced with stringers beneath the top and cleats running at right angles to them, the piece is very sturdy

porarily or to remove them after they have been fitted so that it will be easier to apply the slats. Large screws or carriage bolts should be used for fastening the parts.

Join the assembled ends with a 2" by 3" stringer in front and a 2" by 4" one at the back. The slats should be prepared by beveling the outer edges as shown. Fasten them with countersunk flathead wood screws.

Low table. The size may vary from 16" by 24" to 20" by 60", and the piece will serve as a coffee table, bench, footstool, or what you will. The framework consists of 2" by 3" stock assembled with dowels or mortise-and-tenon joints. Large dowels may be used for the stretchers. The top is made of 1" by 4" boards or other available material fastened by driving screws up through the apron from below.

Double writing table. This has a trestle-type framework of 2" by 4" stock and a plywood top stiffened by cleats. Note that the upper cross members or rails are notched to receive these cleats. Both the posts are ripped to half their thickness for a distance of 8¾" from the top, then grooved to receive a vertical dividing panel. Facings are added as shown to form stationery racks. Dowel joints are best for the framework, but large screws and glue may be used, if preferred.

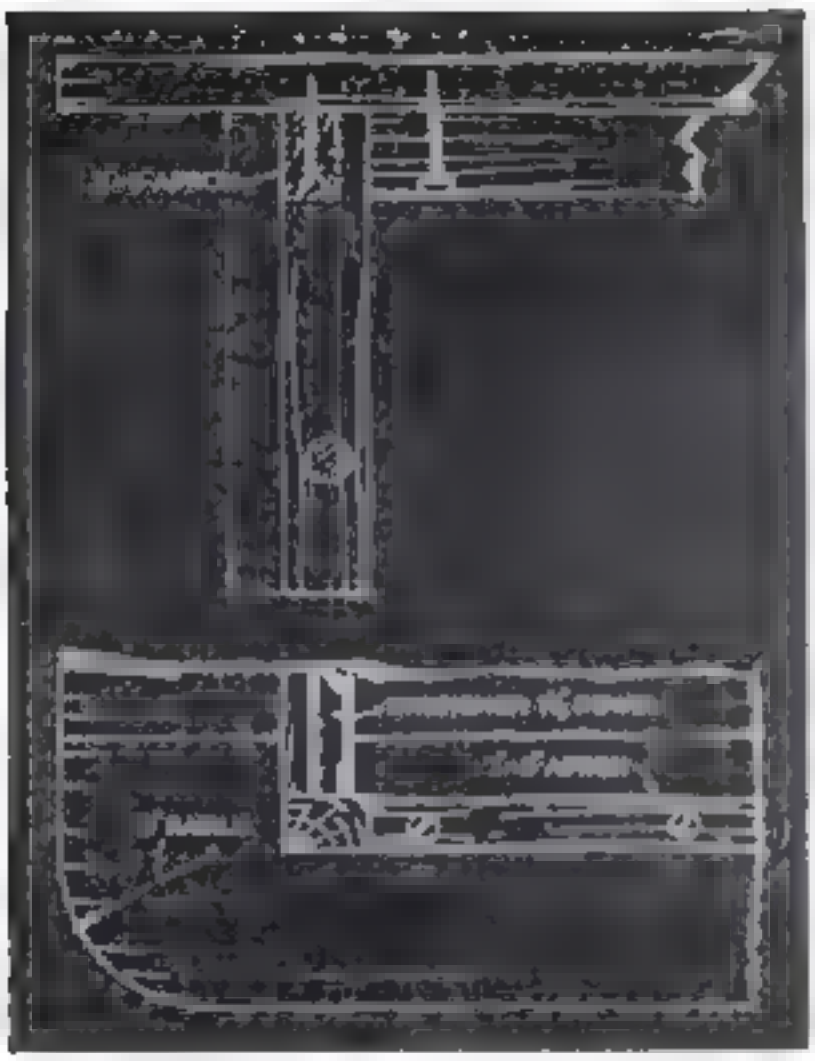
Reading table. Plywood panels ¾" thick, if available, can be used in constructing this table (see list of materials), in which case nails, if plentifully used, will be sufficient. However, glue and dowels will assure a more substantial job. In the absence of plywood, solid stock may be used by modifying the design. Fasten the top to the braces with screws from below.

Finishing. Careful finishing is the best guarantee that these pieces will not look like a rough carpentry job. Countersink all flathead screws and set all nailheads. Round all edges. Sandpaper the exposed surfaces.

What type of finish will depend to some extent upon the wood. If clear stock, such as dressed pine, fir, or redwood, has been used, a natural finish may be chosen. Perhaps the simplest method is to use colored wax, or clear wax over a stain. In the latter case, let the oil or water stain dry thoroughly and seal it with a water-thin coat of shellac. Sand this lightly and apply coats of paste furniture wax or automobile wax.

Wood of inferior quality or salvaged lumber should be painted. First shellac all knots and sappy spots; then apply a priming coat and putty all holes and cracks. Finish with two or three coats of paint. In case the furniture is to be exposed to the weather, a suitable outdoor paint should be used; or, if a natural finish is preferred, use outdoor spar varnish over the stain and omit both the shellac and the wax.

Next month: A game cabinet, sawbuck table, all-purpose round table, and magazine rack.



Utility is the word for this low table, which is constructed of 1" by 4" boards laid on a framework of 2" by 3" stock. Varied in size, it will serve any recreation room as coffee table or bench, or in half a dozen other ways. The finished drawing is on page 163

LIST OF MATERIALS

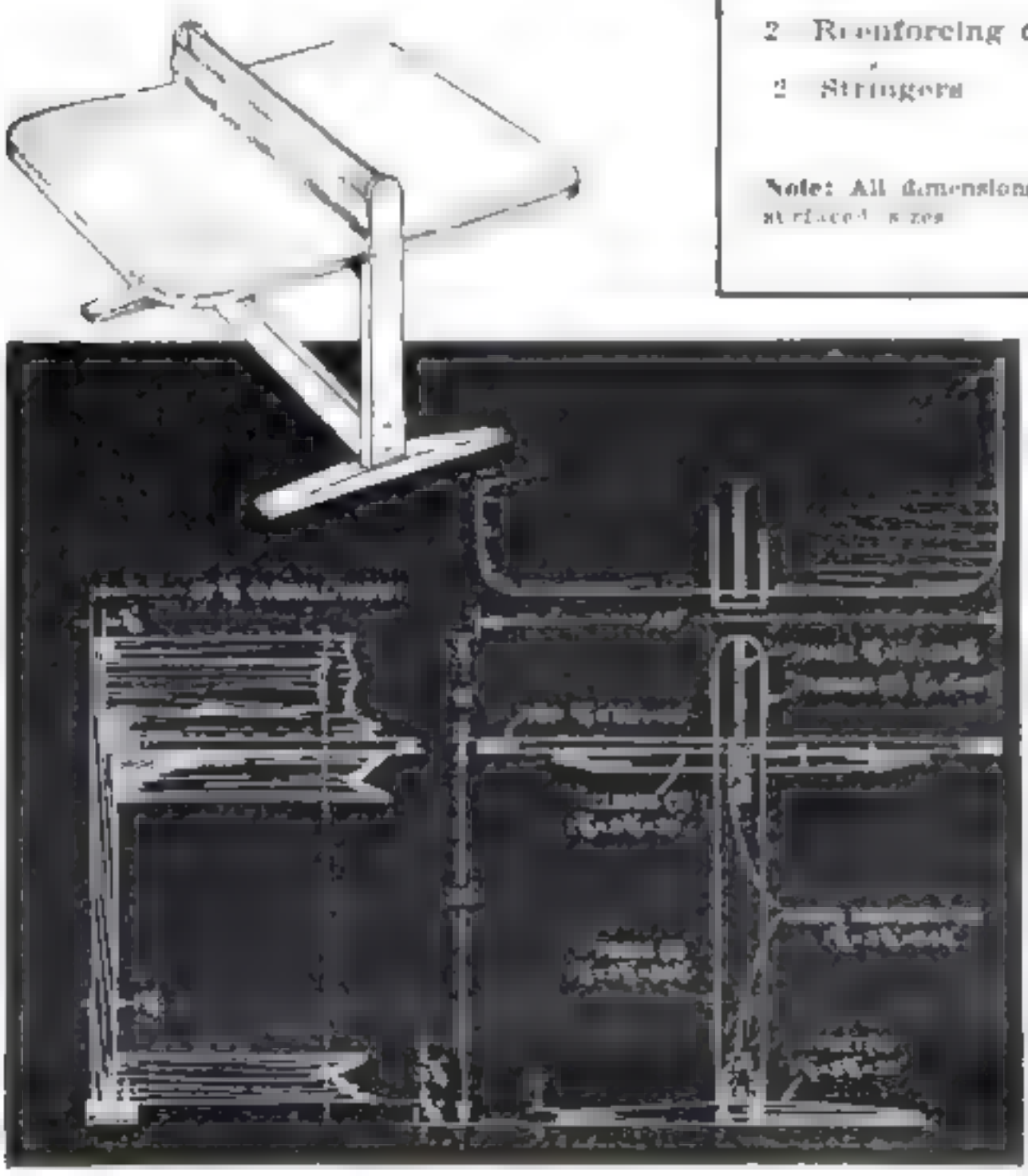
FOR 7' SETTEE

No. Pc.	Description	T	W.	L.
2	Front legs	1¾	3¼	20¾
2	Arms	1¾	3¼	23
2	Back legs	1¾	3¼	18¼
3	Seat bases	1¾	3¼	27½
3	Back supports	1¾	3¼	24½
1	Back stringer	1¾	3¼	76½
1	Front stringer	1¾	2¼	76½
21	Slats	¾	1¾	78

READING TABLE

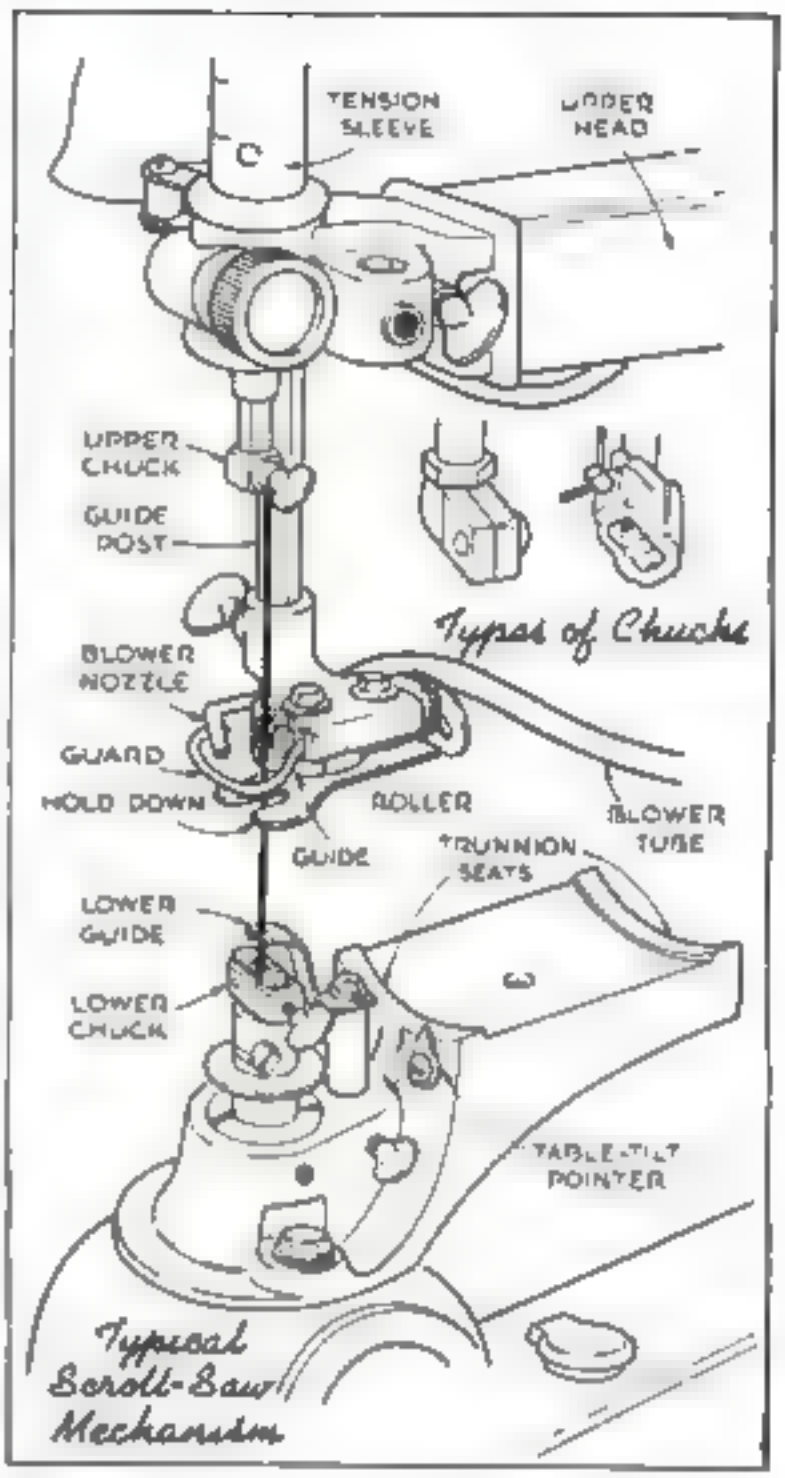
1	Top (plywood)	¾	36	96
2	Uprights (plywood)	¾	29¼	34½
4	Facings "	¾	5	29¼
4	Shelves "	¾	14¼	36
2	Reinforcing cleats	¾	4¼	34½
2	Stringers	1¾	3¼	66

Note: All dimensions are given in inches and are surfaced sizes



Plywood is employed again to top this double writing table set on a trestle-type frame of heavy 2" by 4" stock. The dividing panel and facings, also plywood, make excellent racks for holding stationery

Scroll-Sawing Is Fun



Fret-sawing becomes a fascinating task when done on a power-driven scroll saw. It is easy to do quick and accurate work after a little practice. At right above, principal parts of a typical saw mechanism

By EDWIN M. LOVE

THE modern scroll saw might be called the embroidery machine of the workshop. Few operations are more fascinating than that by which this tool makes lacework of wood. Almost every step of the work is fun, and the suspense of watching beauty take shape under the flashing blade is matched only by the satisfaction gained from the finished piece. The scroll saw is, furthermore, one of the safest of all power tools. With a little instruction, a child can operate it safely.

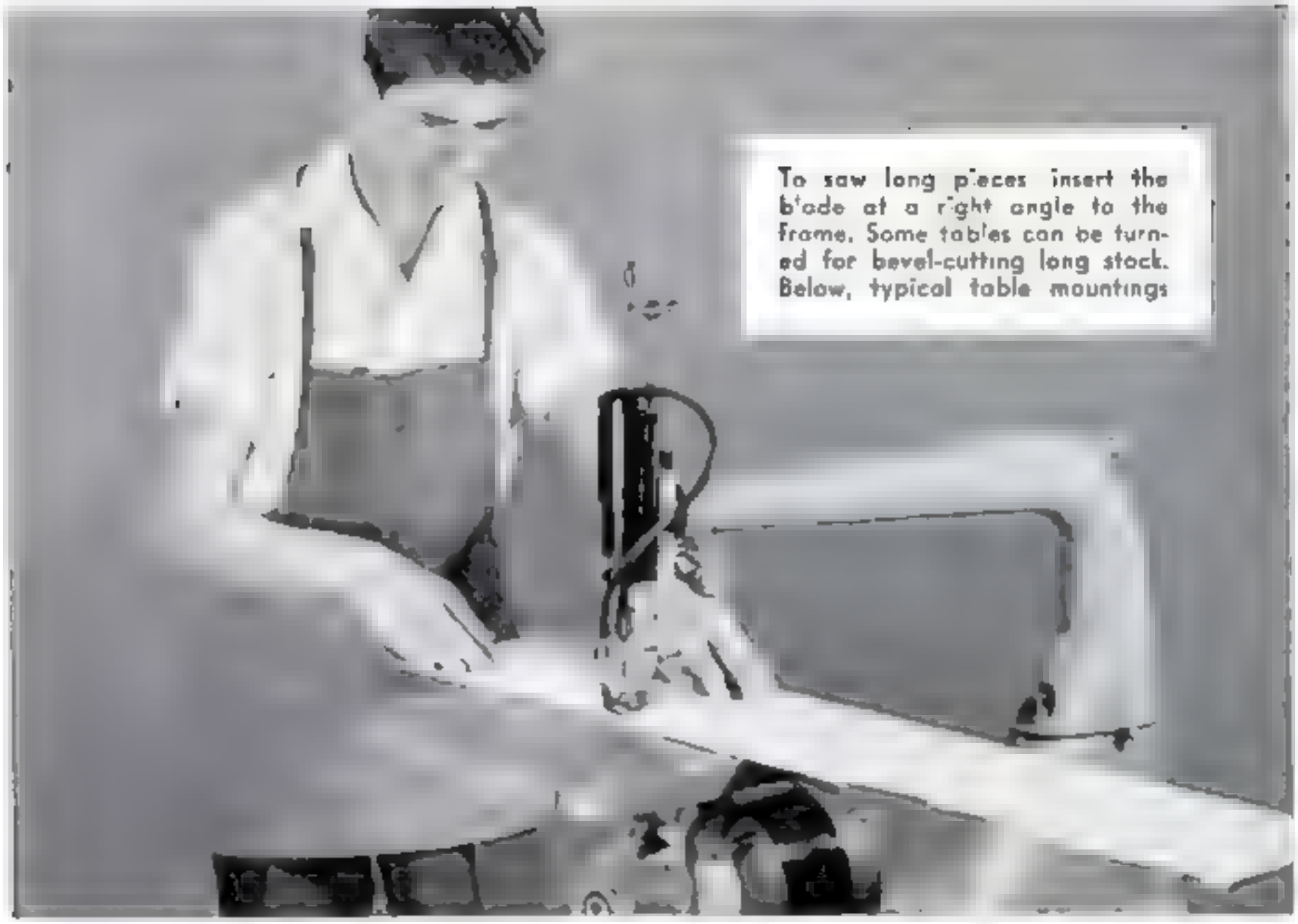
But fret-sawing is only one of the manifold uses of modern scroll saws. They will work lumber up to 2" in thickness, saw bone, plastics, and metal, cut duplicate patterns from paper or cloth, sandpaper contours, and do rapid filing on various materials.

How is a scroll saw set up?

MOUNT the machine on the bench or other support and align its pulley with that of the motor. The V-belt should be just tight enough to run without whipping. Some scroll saws have an arrow on the crankcase indicating the direction in which they must be driven. Reverse the motor rotation if necessary, or turn the motor end to end, to conform to this. Running the saw in the opposite direction may loosen the crankpin and cause extensive damage. Be sure to check crankcase lubrication if the saw is of the type that should be filled with oil.

What kind of blades are used?

SCROLL-SAW blades range in size from barbed threads of steel scarcely thicker than a horsehair—used chiefly in making



To saw long pieces insert the blade at a right angle to the frame. Some tables can be turned for bevel-cutting long stock. Below, typical table mountings

jewelry—to stiff "saber" blades from ⅛" to ¼" wide. A good general rule is to choose thick, coarse-toothed blades for heavy work, or for rapid sawing of work that is to be finished smooth by other means afterwards, and to use fine-toothed blades for intricate cutting or where finishing is impractical. Pieces broken from old band-saw blades often work well in a scroll saw for work that calls for heavy cutting.

A large or medium-size blade can be resharpened by filing. Clamp it in a vise so that about 1" of it projects, and file this while holding the free end. Release and reclamp the blade to expose another section for sharpening. Carefully filed blades will frequently be found to cut faster and smoother than new ones.

Another kink often used when cutting thin stock is to shift the blade up or down between the chucks, or to use a false table under the work after part of the cutting has been done, in order to bring a new part of the blade into play. *(Continued)*

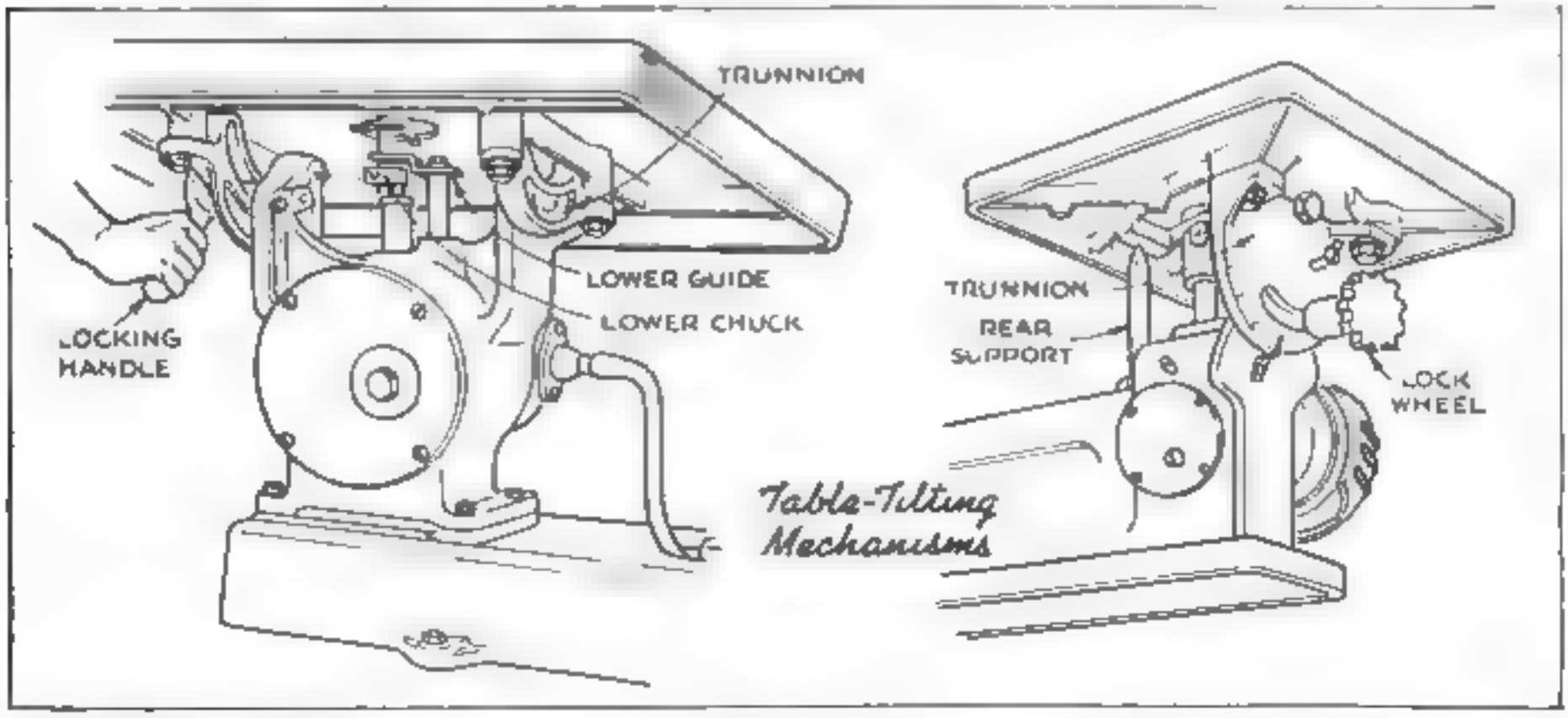
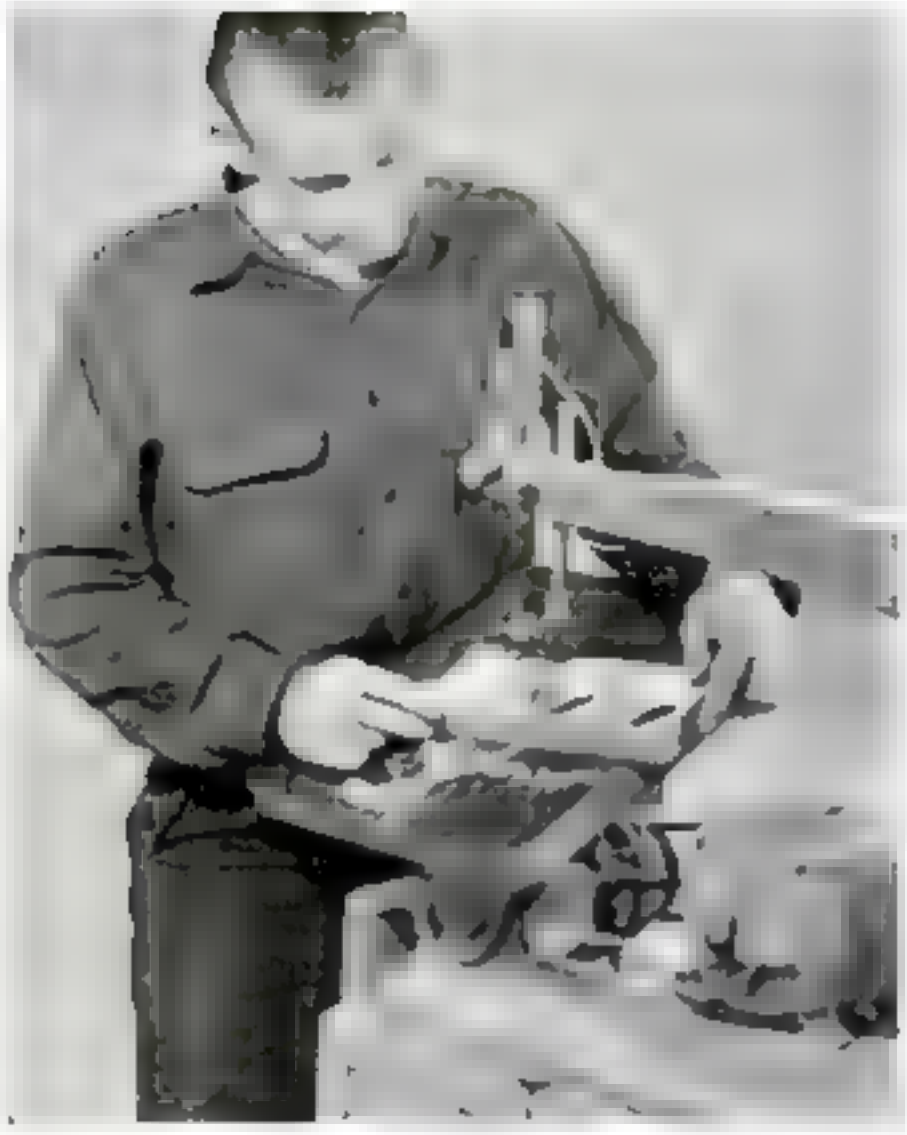
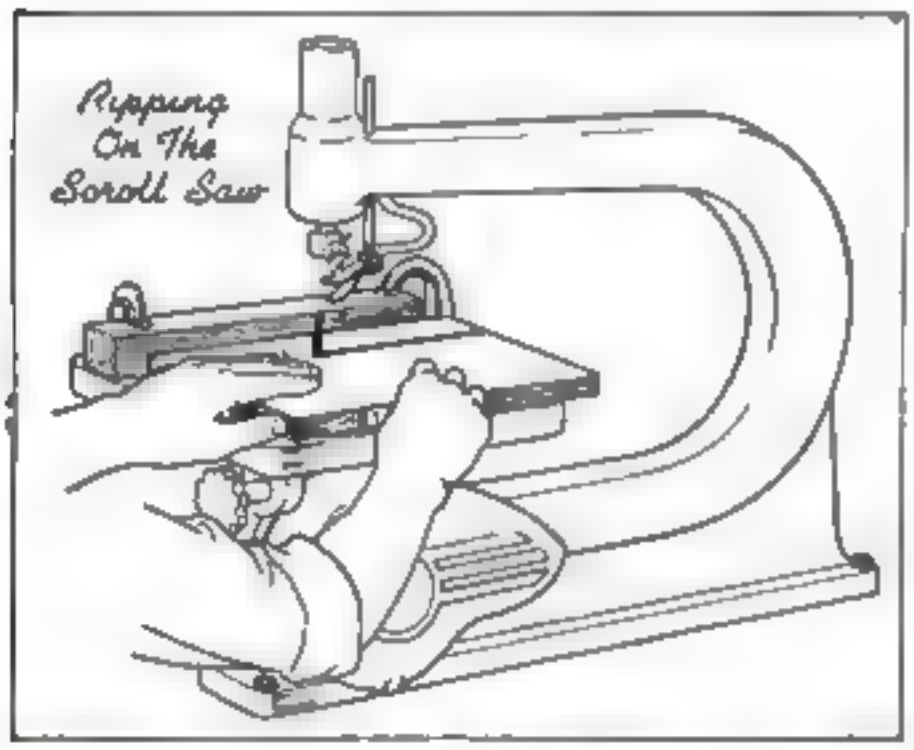
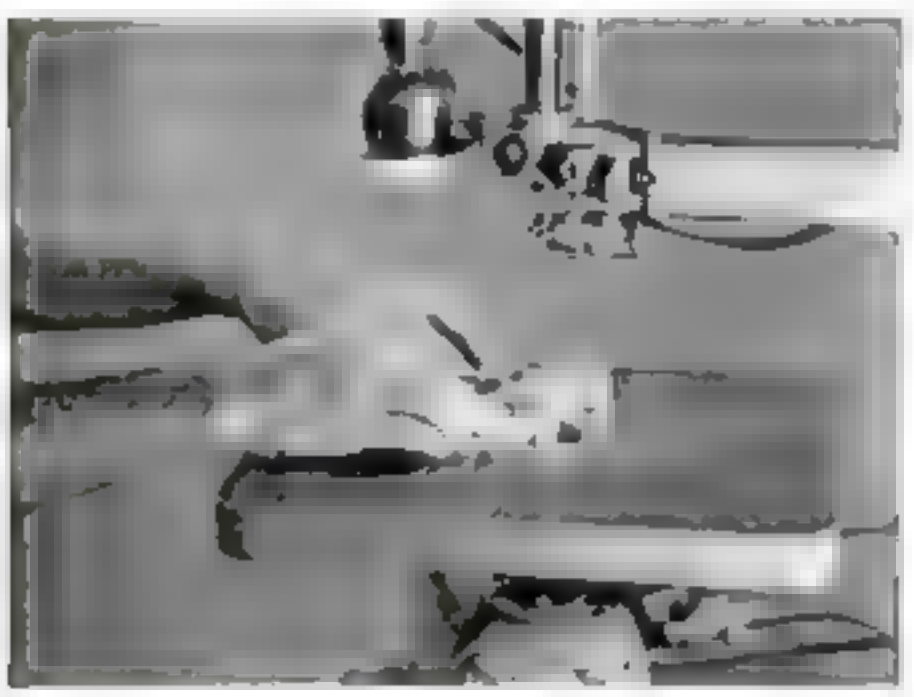


Table-Tilting Mechanisms



In bevel sawing, always keep the work on one side of the blade. Below, ripping with auxiliary fence





Sanding with an attachment clamped in the lower chuck. The abrasive sleeve can easily be replaced

How is a blade inserted?

ON MOST scroll saws one end of the blade is clamped between the jaws of the lower chuck, the teeth pointing down. Lift out the soft-metal table insert to bring this chuck into view. Clamp the other end of the blade in the upper chuck, and tighten the tension to suit the work and the blade. Adjust the roller to touch the back of the blade lightly, and the slotted guide to engage the blade just back of the tooth gullets. Set the hold-down only firmly enough on the work to prevent the latter from jumping.

How is fret-sawing done?

TRACE the design on the best side of the wood and bore holes in the waste portion of all inside cuts to admit the blade. Either do this with a piece of waste clamped to the underside of the work, or sandpaper off any splinters left by the bit, in order that the work may not catch on the table insert. In choosing a blade, remember that although coarse ones usually cut faster, time is often saved by using a fine blade that cuts so smoothly as to make sanding unnecessary. Usually the saw may be driven at its highest speed, except when sawing very hard woods, when a lower speed may be advisable. Split the line so that the kerf or saw slot is in the waste wood. Cut the large curves first, skipping the small ones, which can usually be approached from two directions after the slower curves have been cut. However, with narrow, thick blades that can be turned in their own widths, it is often possible to follow the lines continuously, provided that a slight rounding at corners is not objectionable.

What is duplicate cutting?

THIS means cutting two or more pieces to the same pattern at once. Pile together as many layers of stock as pieces required, placing the pattern on top. Nail the stack with brads driven into the waste wood and clinched beneath. The writer has cut hundreds of names for novelty pins from ⅛" three-ply hardwood by making a "pad" of five 6" by 8" rectangles, and using a thick 1/16" blade. The saw will cut such a pad as fast as the line can be followed, the stack is easier to handle than a single piece, and the cut is smoother. Very thin plywood can be stacked for making scroll-sawed greeting cards, and as many as 100 paper cut-outs can be made at one time by the pad method. Thin plywood must be used at the top and bottom of the stack; nails are then driven through and clinched over underneath.

For all duplicate cutting the table must

be set exactly square. An easy way to check this is to clamp the table lightly, make a test cut, and reverse the work to see if it fits against the blade, as shown in an accompanying drawing. Tap the table with the fist to shift it, and lock it in the square position. It is a good idea to use the blade guide beneath the table whenever possible.

What method is followed in inlaying?

THIS method will be treated in a later article. Simple inlaying, or *intarsiatura*, consists of cutting a pattern from veneer and sinking it flush into a piece of wood of a contrasting color.

How is heavy work handled?

USE thick, coarse-toothed blades, and leave a little stock for smoothing, if the cut is to be finished. Saber blades are preferable in most cases. For bevel cutting, tilt the table at the required angle, and the hold-down also, if it is adjustable. Make the entire cut with the work on the same side of the blade; if the work is swung to the other side, the bevel will be reversed.

Are sanding attachments really useful?

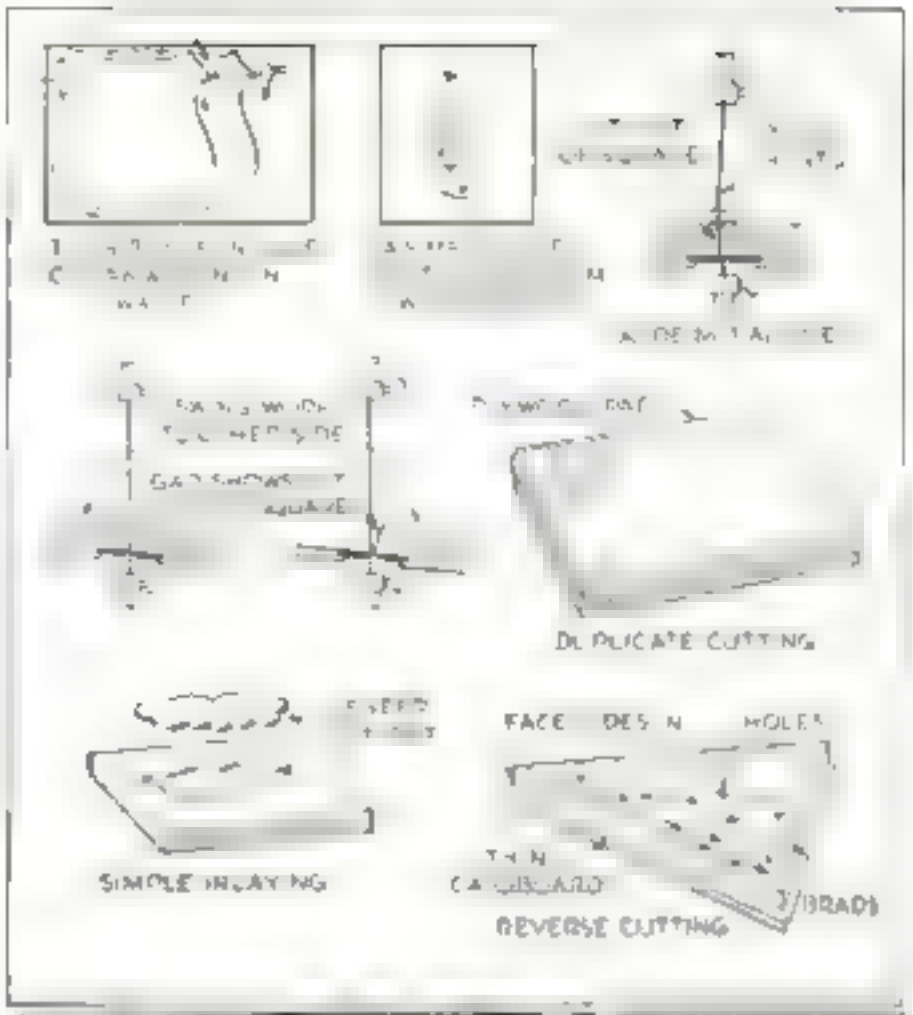
THEY work very well. Some are simply sticks faced with sandpaper and hooked on pins held in the chucks. One attachment uses a sandpaper sleeve and is held like a file in the lower chuck only. Operate the machine at a slow to medium speed, sliding the work from side to side and applying light pressure. Fine sandpaper requires the slowest speeds. Bastard files broken to suitable length are excellent substitutes for sanding attachments. They cut almost as fast as sandpaper, wear indefinitely, and can be cleaned with a file card.

How is metal cut on the scroll saw?

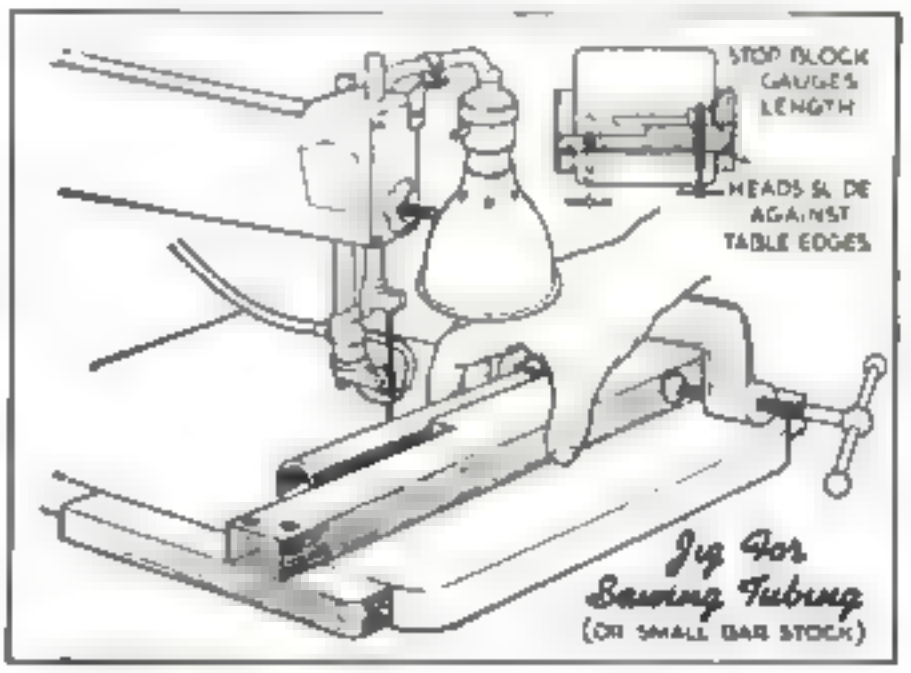
VERY much like wood, but at slow speeds and with blades having teeth fine enough so that two or more span the thickness of the sheet or stack to be sawed. Aluminum can be cut at fairly high speed and with coarse teeth, but harder metals demand slower speeds and finer teeth. Plastics work much like soft metal or hardwood plywood. With some types too rapid cutting results in gumming or discoloration due to heat.

What types of files may be used in the scroll saw?

MACHINE files, with teeth pointing downward to draw the work against the table, are best, but ordinary files also can



Above, some scroll-saw hints. In photo, filing a stack of aluminum cut-outs. Below, sawing tubing



be adapted. The regular table insert usually cannot be used, but one should be cut to suit if the metal is thin enough to require support close to the file. A false table of ¼" plywood also can be used. Keep the speed slow. At high speeds the file will simply scrape the work without cutting. The finer the file, the slower the speed should be.

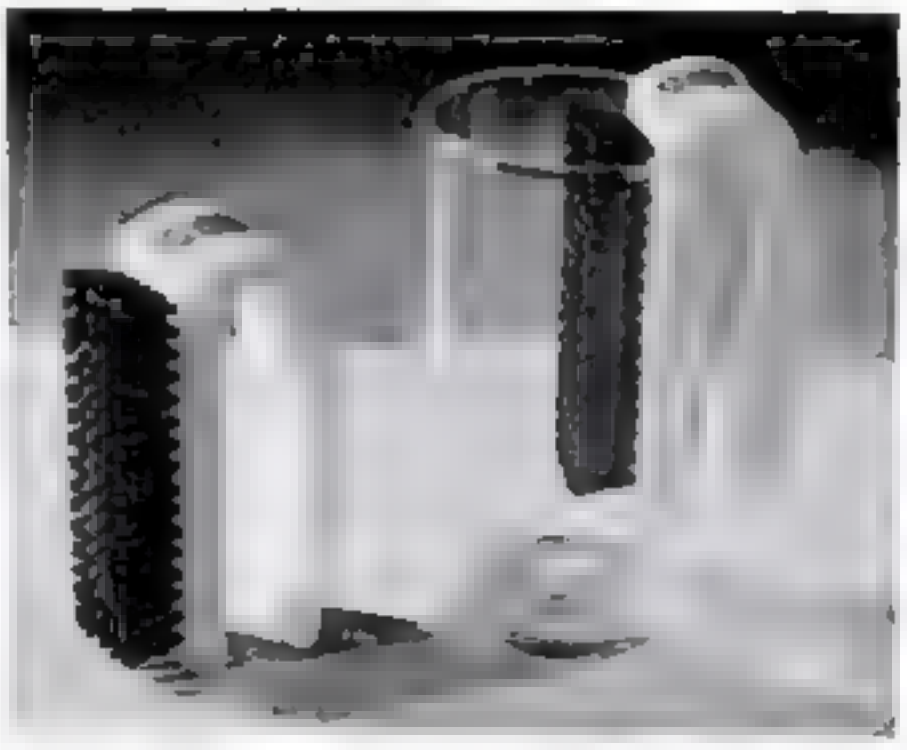
New Appliances

SWINGING OUT ON A DOOR, the broiler attachment of this new gas range is easy to get at for turning the meat and removing it when done. The device is circular, and the pan and grill lift out from a rack which rests on a vertical screw for adjusting its distance from the top flame. The grill is 14" in diameter, and it will hold two medium-sized chickens or 7 lb. of steak

PICKING UP HAIRPINS from the floor is kept from being an exercise in bending by using a magnet on the end of a plastic stick (below). Groping around on the floor, with consequent damage to skirts and stockings, is avoided. The little magnet is round and is attached to a disk, which is part of the 20" long handle—just long enough to prevent stooping. The gadget is finished in white

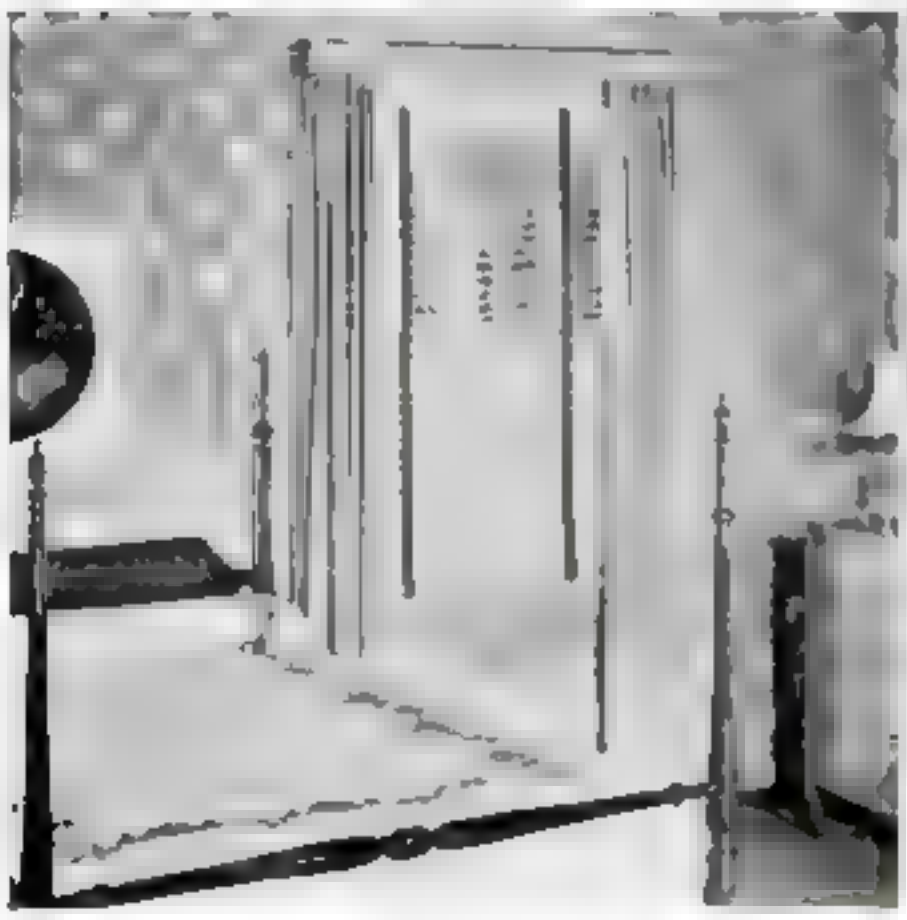
CUBES OF A CLEANING SUBSTANCE that dissolves in water are a new household aid. One cube is sufficient to make a half-gallon of noncaustic and nonacid fluid, which can be used on woodwork, washable wall paper, and upholstery as well as for general cleaning. Each package contains 75 cubes

NONSLIP NAIL BRUSHES are a recent arrival from London. The plastic back is designed for a firm grip in wet, soapy hands, and is hooked for fitting over the rim of a bathroom glass or as an aid to standing the brush on end. Black bristles are reenforced and set into a self-draining base



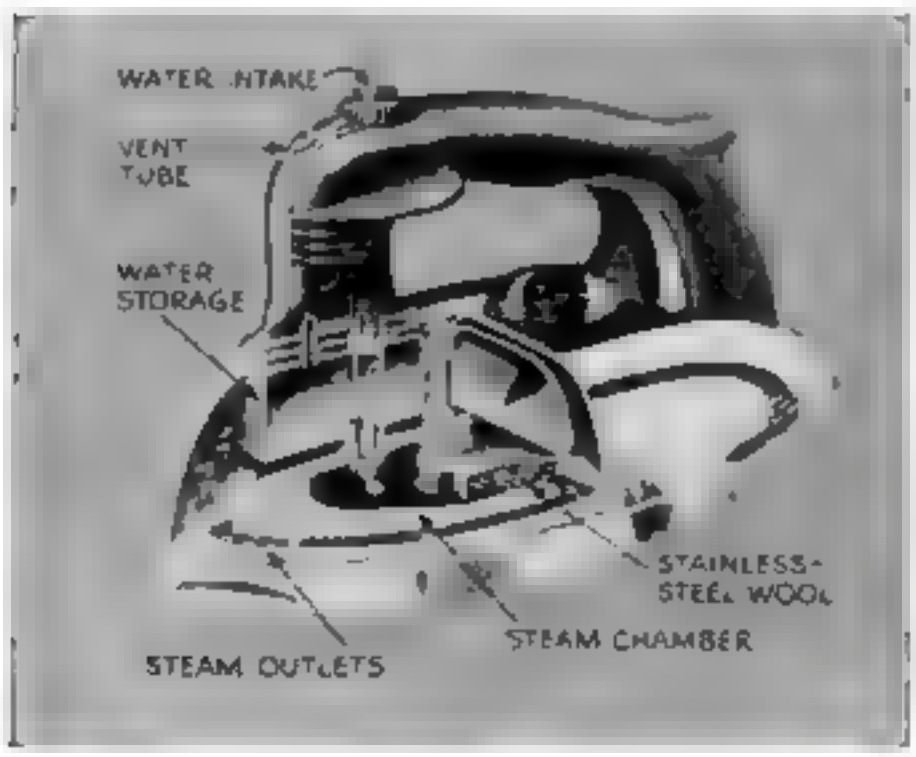
for the Household

VENETIAN BLINDS THAT ADMIT A GLOW when drawn instead of shutting out all light are made with translucent fabric slats which give as much privacy as the ordinary opaque wooden ones. Another feature is an attachment (two metal clips fastened to the tapes) that will permit the opening or closing of the lower or upper section independently, yet they can also be operated as a unit. Being flexible, the slats are easy to dust; they are also washable



Hand-blocked gay, modern patterns and colors are a special attraction for the kitchen to be had on the new translucent Venetian blinds

STEAMING IS CONTROLLED without pressure in this new iron, and may be stopped entirely without emptying the water when straight ironing is to be done. A knob on the handle regulates the amount of steam generated, and another on the top of the iron, marked in fabric names, sets the temperature



ATTACHED BETWEEN MATTRESS and spring, this utility pocket with moistureproof lining will be found handy for toilet articles and a handkerchief. A stiff, cloth-covered board at the top is slipped between mattress and spring to hold it in place. A luminous button marks its location in the dark

Colorful and attractive results are obtained with chicken bands linked together to form the novelty bracelet above. As a variation, small pendants or charms may be attached at intervals to the rings

Novelty Bracelet Made from Chicken Bands

IN JUST a few minutes you can make this gay novelty bracelet from celluloid chicken leg bands or markers. These come in various bright colors and several sizes—¼", 9/16", 11/16", and ¾". They are sold at trifling cost by the package in many hardware stores; they can also be obtained from dealers in poultry supplies, and, of course, from large general mail-order houses.

One marker serves as a fastener. Through this three markers are slipped and pushed close together. Then three other rings are slipped through them. Continue until a bracelet of the desired size is obtained. Slip the fastening ring through the last three rings. Four rings may be used instead of three, if desired, or a pattern may be obtained by alternating three and four rings or using two colors.—BENJAMIN NIELSEN.

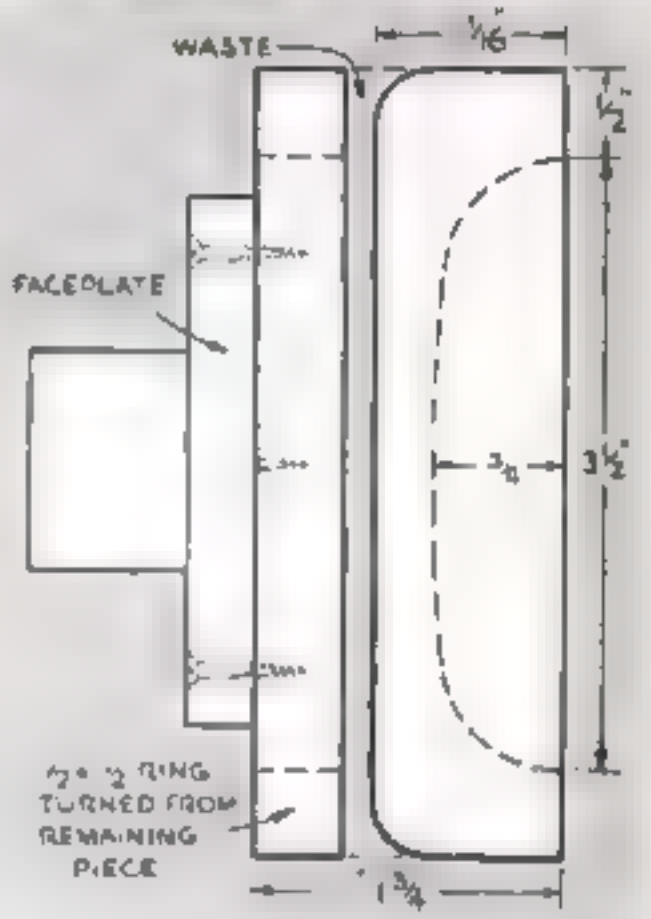
Leg bands are easily slipped through each other in threes or fours or in an alternating pattern

Cut the bowl in half across the grain and match it up with the grain of the handle so as to insure the most decorative effect

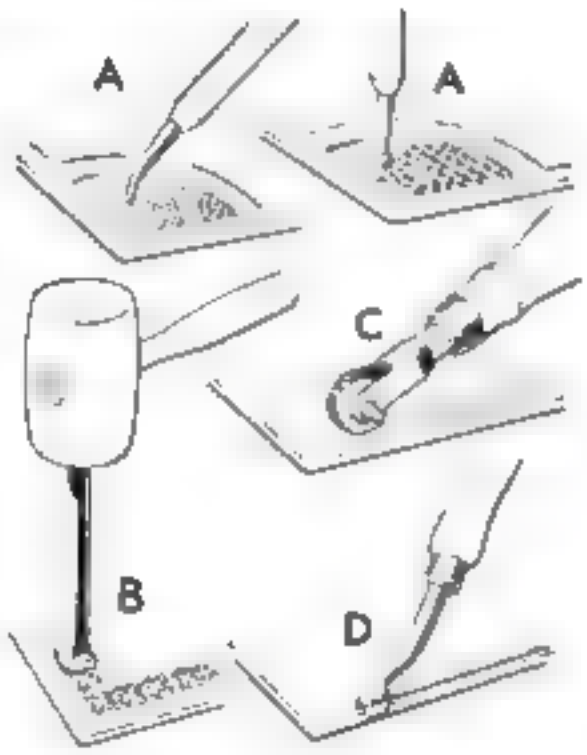
Turned Wooden "Basket" for Flowers Blends with Your Furniture

Craftsman: 1¼ hours
Beginner: 3 hours

TURNED from hardwood, this "basket" for holding flowers is made almost entirely on the lathe. A single disk of wood, large enough to be turned to 1⅝" thick and 4⅛" in diameter, is the only material required. Walnut or mahogany is suitable for the average living room, but maple or cherry will also make beautifully ornamental pieces if they blend with the furniture. First, the bowl part is hollowed out and separated from the remainder of the stock on the faceplate, as shown in the drawing. This section is then cut in half to form the two sides. Next, the remaining stock is turned into a ring ½" thick and ½" wide. After the parts are glued together, sand off a portion of the bottom to furnish a base. Finish with several coats of shellac, sanding between coats.



ENRICHING BACKGROUNDS AND EDGES [LEATHER CRAFT—7]



Backgrounds may be enriched by stippling with small end of modeler or ball point while leather is still damp. Use light tapping motion as at *A*, and be careful not to break through the leather surface. Stamping tools of various designs are used by holding them at right angles (*B*). Tap them lightly with a mallet, but don't cut through the surface. Original designs may be made by filing nailheads to various shapes. A leather worker's embossing carriage (*C*) with interchangeable wheels may be used. Run the wheel along a straightedge to insure straight lines, and use sufficient pressure to impose a clear design the first time over the leather. Open edges of pockets and belts may be enriched by creasing a line with single-edge creaser (*D*).

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Mandarin Knitting-Yarn Holder

DESIGNED BY JUAN OLIVER

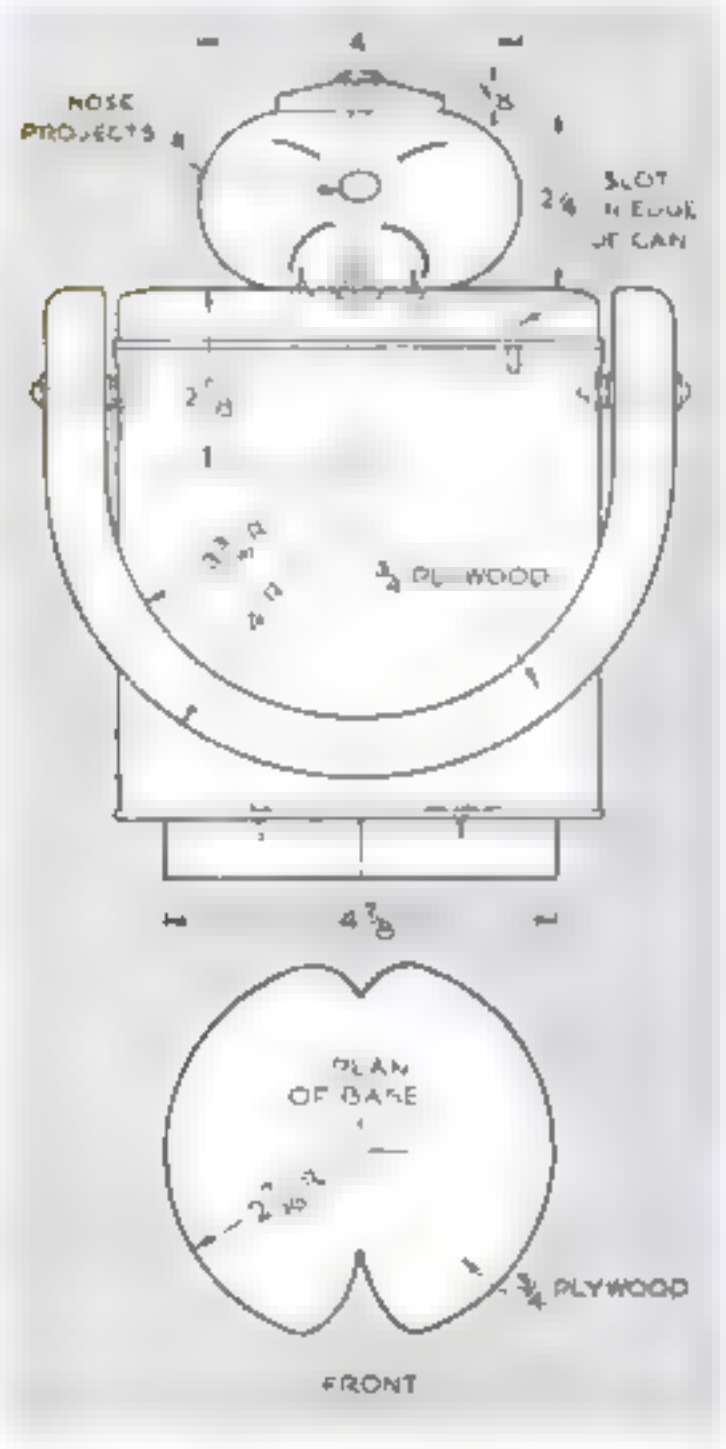
DECIDEDLY different, but very easy to make, this yarn holder is big enough to hold partly finished work as well as a good-sized ball of wool. The body of it is nothing more than a 6" diameter tin from a kitchen canister set. Cut a narrow slot in the edge of the can to about ⅛" below the lid line, as shown in the drawing. This is to permit tucking in the yarn when work is kept inside.

The head is a simple faceplate turning, drilled through with a ¼" bit and counterbored at top and bottom to a close fit for two hard-rubber insulating bushings such as are used in electric-socket caps. The yarn pulls out through this hole as the knitting progresses, and steel and plastic needles of small diameter may stick up through it when the work is stored inside. Fasten the head to the lid of the can with three roundhead wood screws.

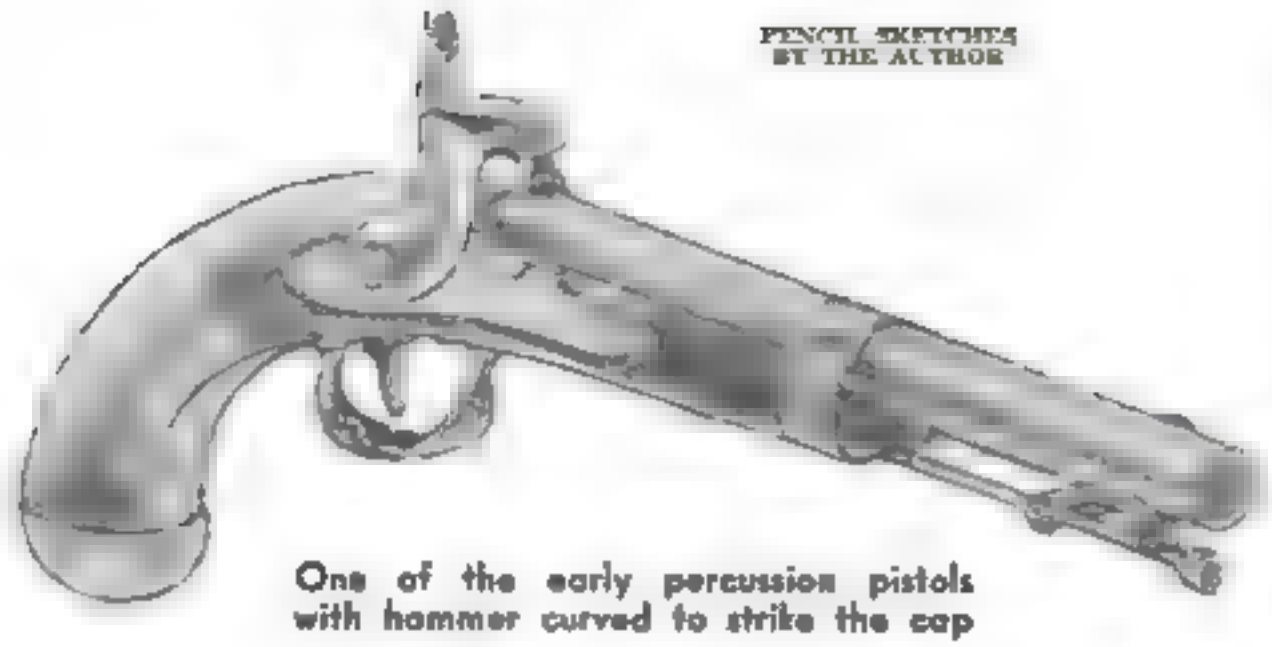
Saw the handle from ¾" plywood and drill the two ends for small machine screws. Use two washers and two nuts at each side, one on the inside of the can, and the other between the can and handle, tightening just enough to allow the handle to pull up easily. The feet are sawed from ¾" pine, with a deeper cut for the toes than for the heels. They are then attached with three roundhead screws.

Paint in slanted eyes, mustache, and pigtail. Color a short section of the handle to represent cuffs. Decorate the canister with fanciful "Chinese" characters, dragons, or other appropriate markings.

This sinister shade of Fu Manchu really is very harmless, and he has a good heart, consisting of a ball of yarn that winds through the top of his head as knitting needles click out sweaters or other wear



Working drawing of the yarn holder, with dimensions for construction. The arms are shown as if hanging in a vertical line to present more clearly their true shape



PENCIL SKETCHES BY THE AUTHOR

One of the early percussion pistols with hammer curved to strike the cap

Ball-and-Cap Pistol

IN HALF-SIZE SCALE MODEL WHITTLED FROM WHITE PINE

By Carl G. Erich

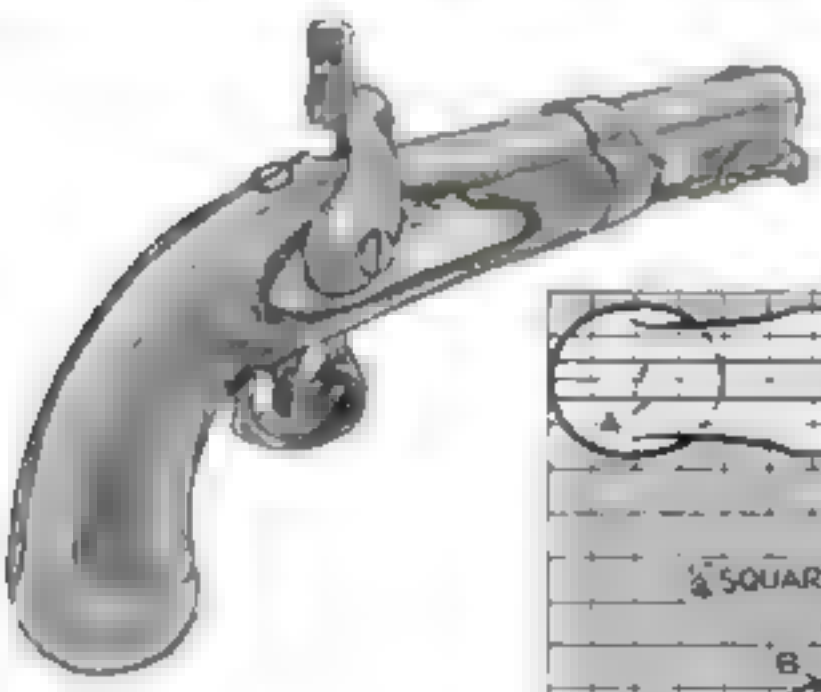
MARKING the change from flintlock to percussion firearms, pistols of this type were manufactured in this country during the second quarter of the last century. On the earliest models, the old flint hammer was used with the side lug; then a new type of hammer was substituted, and still later the cap holder was moved to the center of the barrel butt and the hammer curved to strike it, as in the model illustrated.

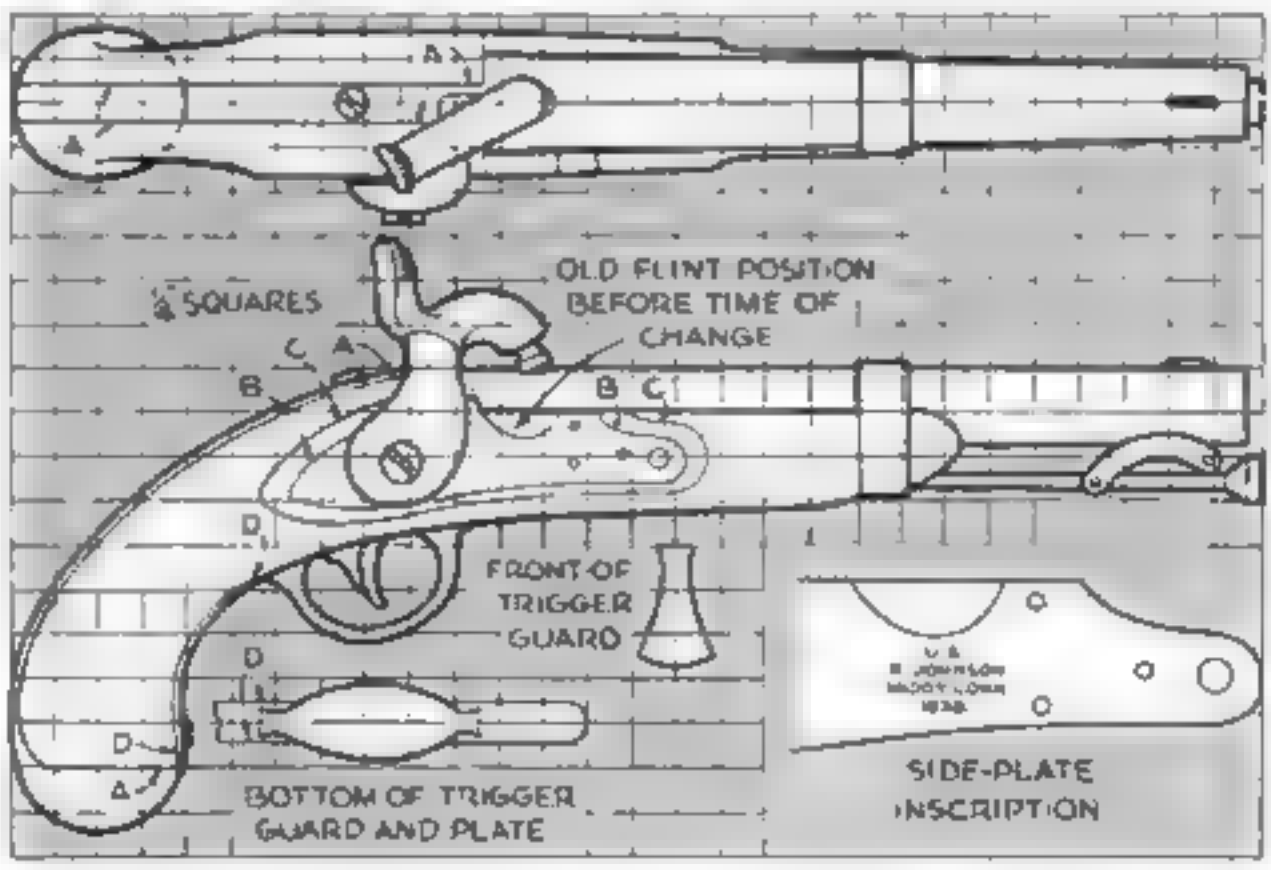
The original of this pistol was made in Middletown, Conn., and carries a side-plate inscription giving the name of the manufacturer, R. Johnson, and the date, 1838. The model is half size, exactly 7 1/32" long over all and 27/32" thick, not including the hammer, which is carved separately and glued and doweled in place after the remainder has been completed.

Lay out the design on ¼" squares and transfer it to 1" thick white pine. Cut out the trigger guard first, boring a hole on the inside and jig-sawing as in the method described for previous models in this series; then saw the entire outline. A center line drawn around the sawed edge will serve as a guide in whittling the edges, and cardboard templates will be a help in obtaining the correct contours when carving the shape. Follow carefully the details in the accompanying sketches.

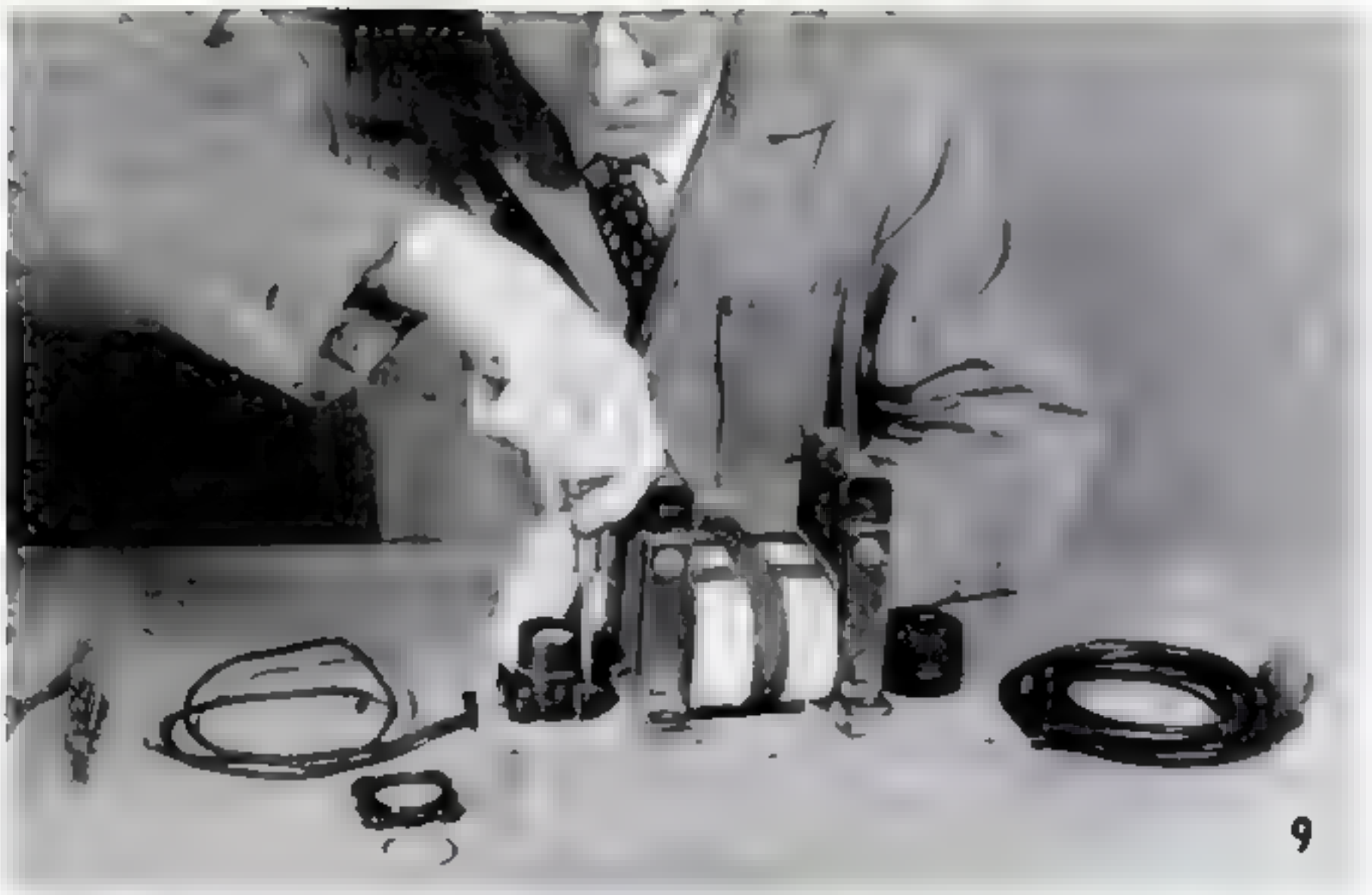
Make small V-cuts, as shown, connecting points *AA*, *BB*, *CC*, and *DD*. Notice the course followed by *AA* around the front of the butt. The barrel may be bored ⅛" to a depth of an inch or more. Use pieces of dowel, rounded and slotted at one end, for all screws. The model may be left natural or colored.

This and other historical firearm models described in past issues may be mounted together on a panel. Glass placed in a frame extending out 1⅛" or so from the panel will keep them free from dust and neat in appearance. The display should prove a center of interest over a mantel or on a wall of a den, library, or game room.





Working drawing of a pistol of the ball-and-cap type. Carving the ramrod, shown in its holder underneath the barrel, is a delicate piece of work. The end should be hollowed as if to fit the ball which the pistol fired



How to Complete and Use Our

Adjustable GROWLER

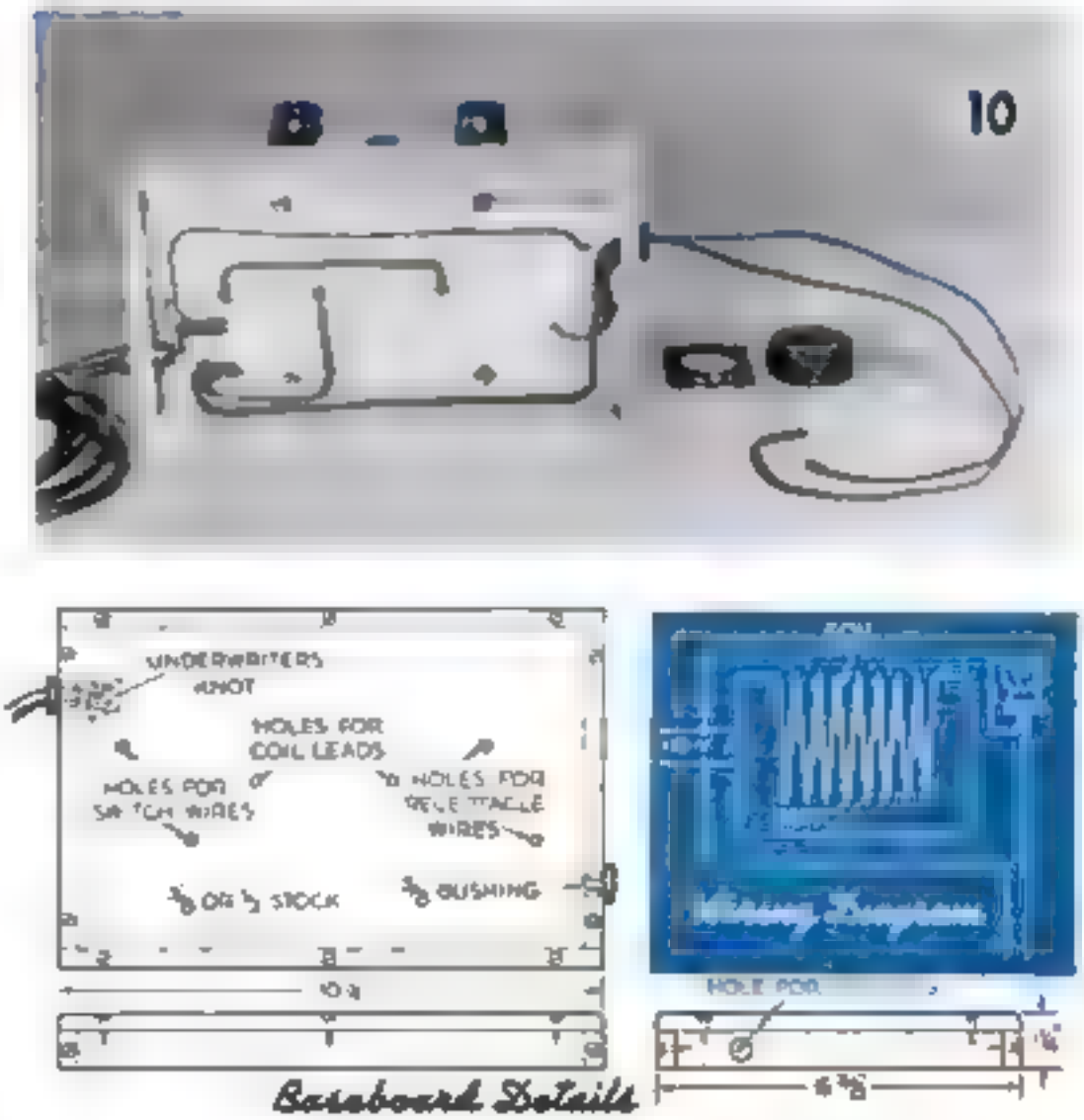
for Testing Armatures

By HAROLD P. STRAND

TO SIMPLIFY the work of fitting the pole pieces to the core of the growler, the construction of which was described in the first part of this article (P.S.M., Dec. '41, p. 193), the finished parts may be mounted upon the baseboard. This is preferably a shallow box made of ⅝" or ½" thick oak or other hardwood. Dimensions are given in the drawings, and Fig. 9 shows the arrangement of the three units on the baseboard.

Both the receptacle and the toggle switch are of the surface type, and may be composition or porcelain. The test leads and the line cord enter through hard-rubber bushings. Four short 3/16" bolts secure the growler to the base.

Figure 10 shows the base wiring. The taps for the series lamp



Baseboard Details

are soldered and taped. Use No. 18 flexible insulated wire for all connections, as well as for the two test leads. Slip rubber tubing over the winding leads where these pass through the base.

The baseboard and core brackets are finished with two coats of black enamel, but the core is best left unpainted. Insulating varnish is applied over the coil. Allow 24 hours for drying.

Eliminate any burrs in the slots by using a fine-cut file as in Fig. 11, which shows one pole assembled. Great care must be taken to construct the joints so that they work freely. Start by fitting four short round-end laminations into the first slot of the core leg. Push the brass hinge pin through just far enough to hold these while the next group is inserted (Fig. 12). Select pieces to fit each individual slot as closely as possible. If four laminations are too tight, the slot may perhaps be filed slightly, or three laminations used instead. The thickness of the completed joint, when it is drawn tightly together by means of the wing nut, should be equal to that of the core leg, and it should be possible to move the pole pieces when the wing nut is loosened.

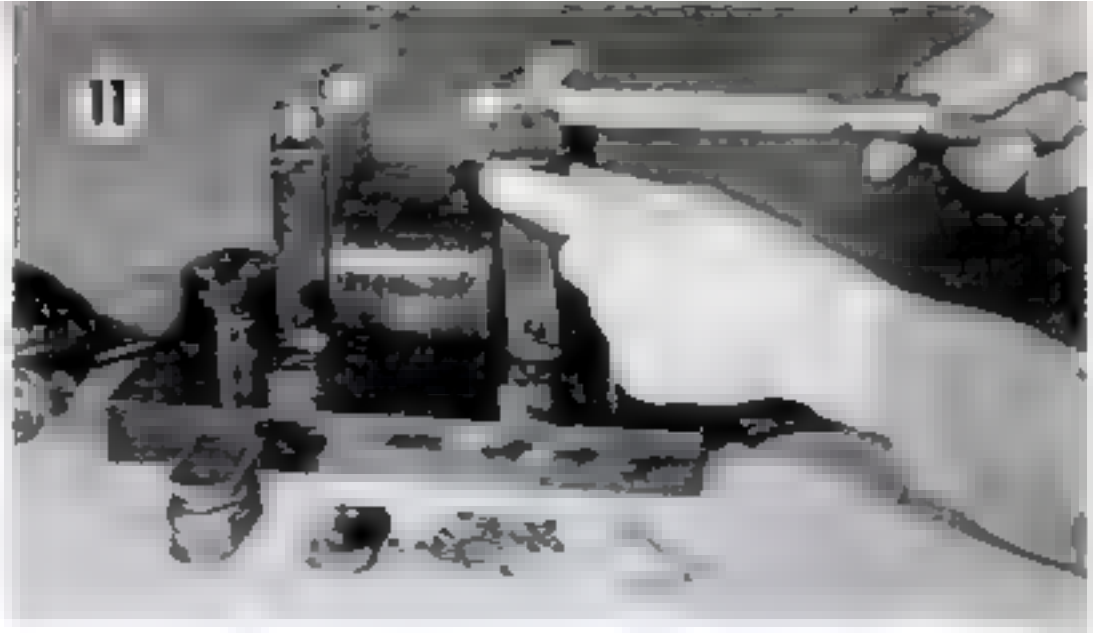
The upper ends of the pole pieces are locked together by fitting two small iron washers into each slot and passing a 3/16" by 4" stove bolt through the parts. File the washers individually, if necessary, to maintain correct spacing. Figure 13 illustrates this part of the assembly.

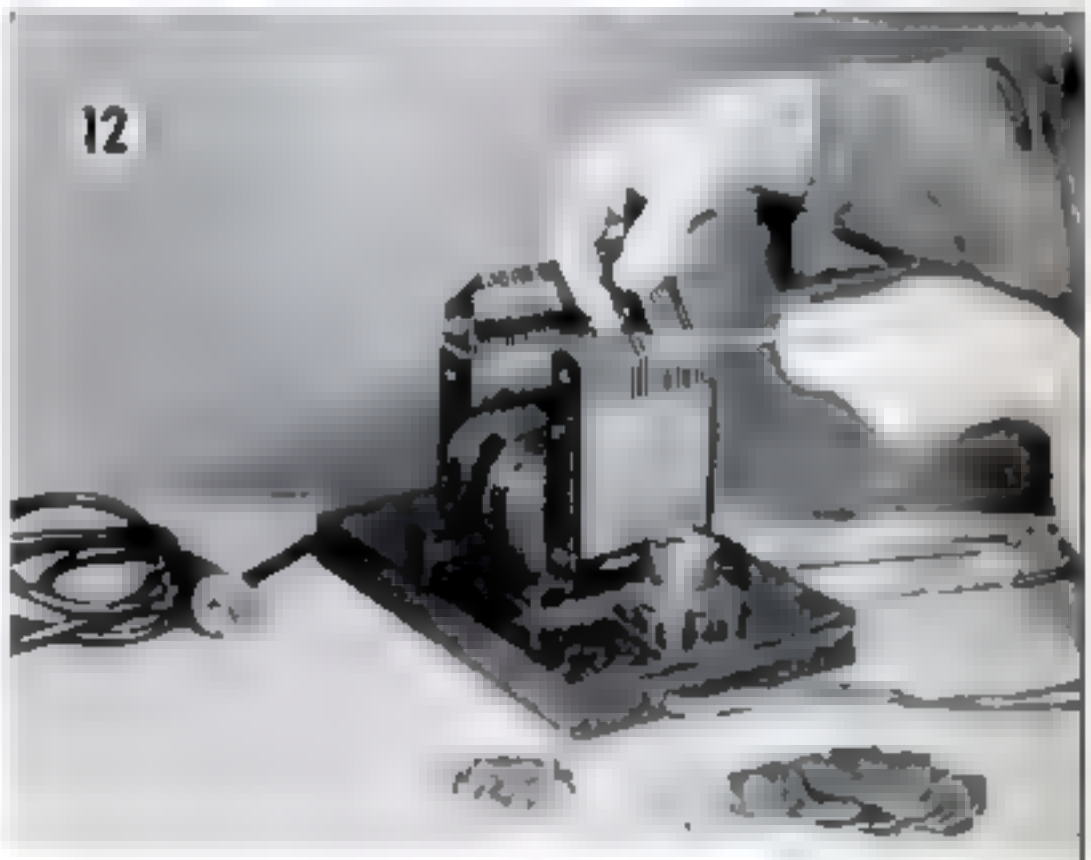
The ends of the pole pieces should be filed smooth and flat across as shown in Fig. 14. This completes the growler (Fig. 15).

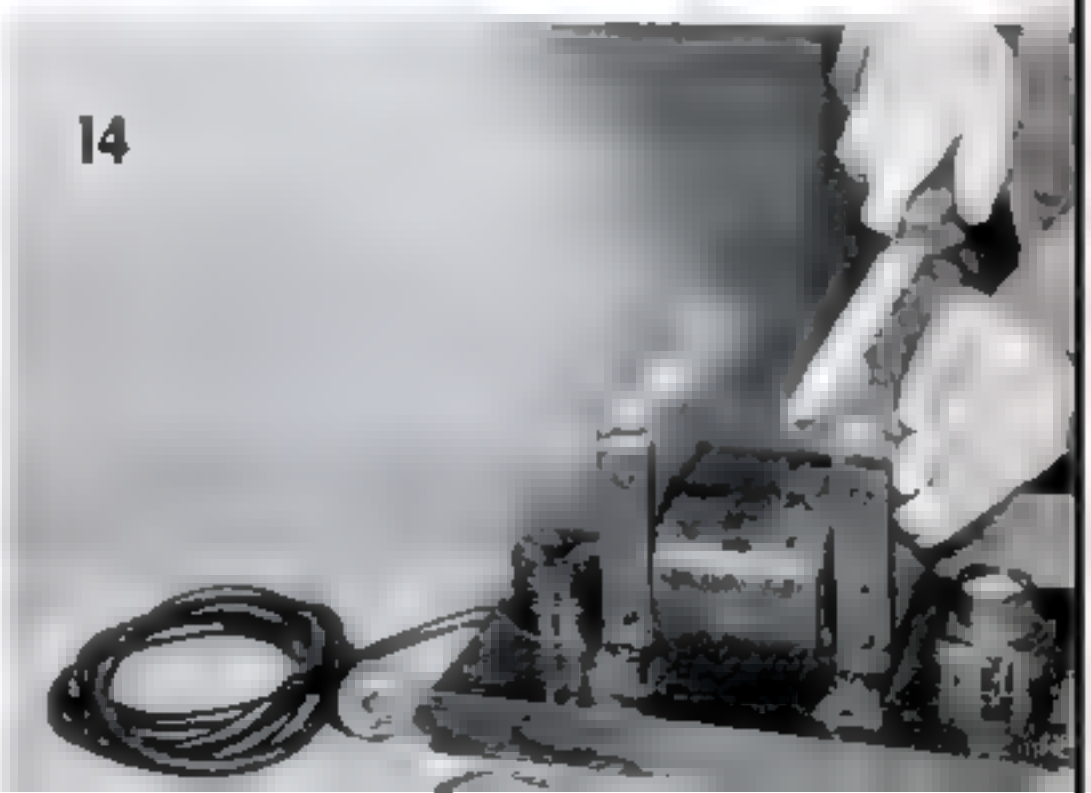
Suitable test prods should be soldered to the leads connected with the series lamp. An easy way to make the prods from ordinary No. 10 rubber-covered solid copper wire is shown in one of the drawings. Leave one lead somewhat longer than the other so that the prod tips will be less likely to touch each other accidentally.

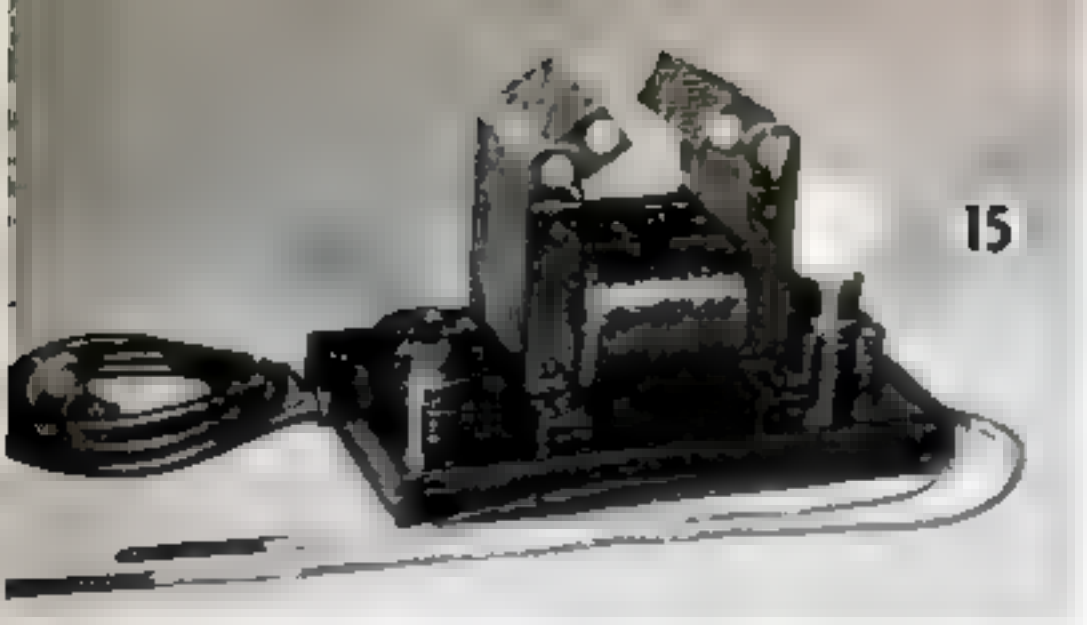
To test an armature, place it on the growler as in Fig. 16, adjusting the pole pieces to suit, and only then turn on the switch. A loud hum, from which the device derives its name, may now be heard. Hold a hack-saw blade at the top of the armature, and slowly turn the latter through at least one complete revolution, keeping the test blade at the top. If the winding is intact, no magnetic attraction will be felt. Avoid testing on the side of the armature, as the growler poles may attract the blade there.

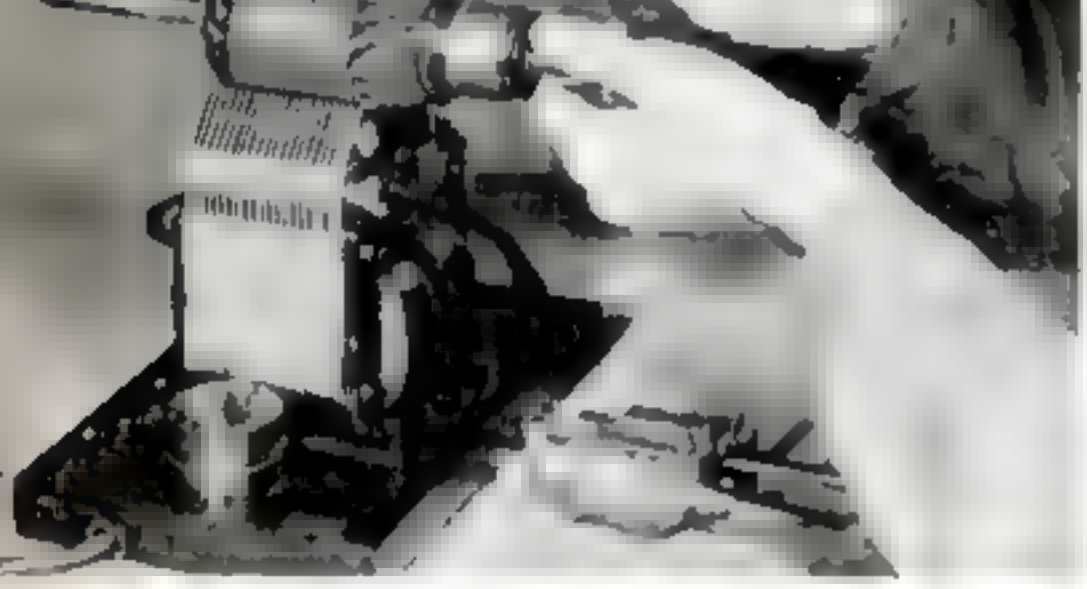
Should there be a short-circuited coil, it will cause the blade to be attracted to the armature when that coil is directly beneath. Mark the spot and continue rotating the armature. If attraction is evident at more than one point, either more than one coil

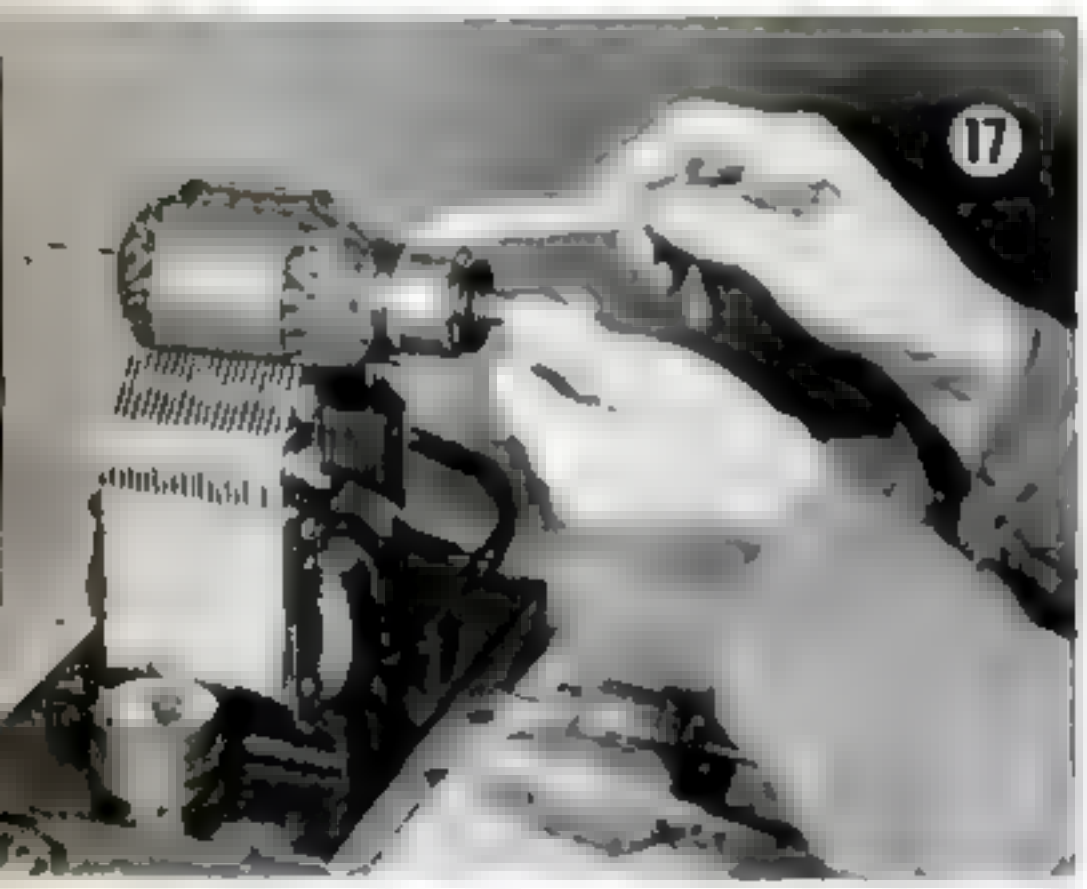


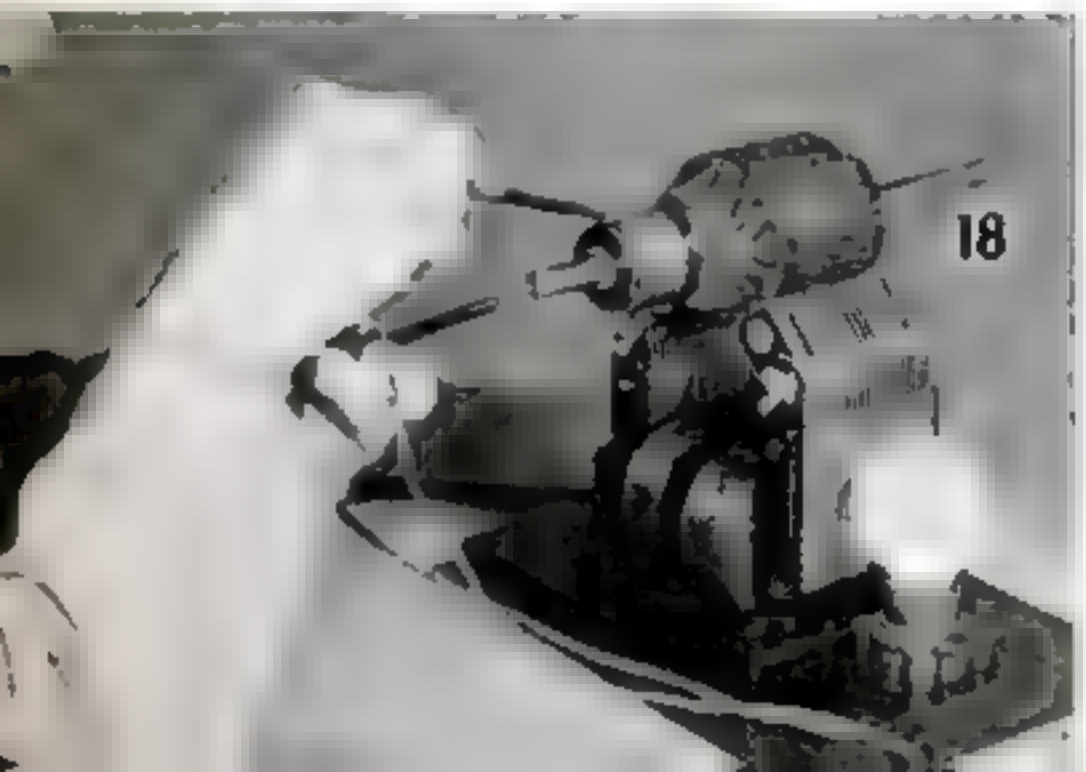





15


16


17


18

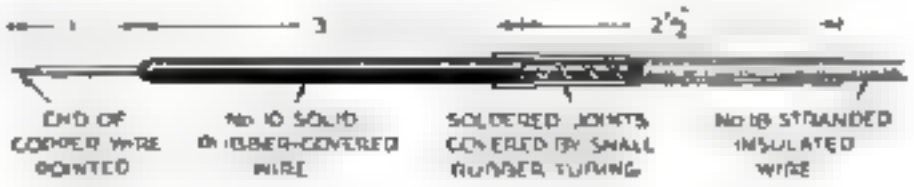
is short-circuited or there is a short between coils.

Before deciding upon a rewind job, examine the commutator. The bars may be deformed enough at one or more points, due to long wear, to bridge the mica-insulated gap between them. Particles of copper or of carbon from the brushes may have lodged in these gaps. To remedy either condition, undercut the mica at each gap slightly with an old hack-saw blade as shown in Fig. 17. Grind one end of the blade off, and grind back both sides of the toothed edge to remove all set and reduce the thickness. Use the blade with the rake of the teeth toward you, so that it cuts on the backstroke. This operation should remove all deposits, and the armature should then be tested again.

If the insulation between the bars is already deeply cut, it may be advisable, after the final test, to fill the gaps with a paste made of powdered mica and water glass or shellac. When this has hardened, undercut each division slightly and smooth up the commutator in the lathe with fine sandpaper. Should the armature still fail on test after undercutting, check the coil connections to each commutator segment for shorts between the leads, and see that all are tightly soldered and that no shorts exist between the risers.

To continue testing the armature on the growler, bridge the two adjacent bars at the top of the commutator with a tool or short piece of thick wire and turn the armature until all the bars have been at the top and have been tested in this way. A spark should be obtained on each pair. A low-reading A.C. voltmeter may be used for this test, and should give the same reading across all pairs. No spark or voltmeter reading indicates a short between coils or a short-circuited coil, or else a short between commutator bars. A low reading may indicate the same faults, but a high reading or an unusually heavy spark between two bars means an open circuit. A 75-ohm telephone receiver may be touched across the bars for this test; the same hum should be heard across each pair. If the pitch is lower at one point, a short circuit is indicated; if higher, an open circuit.

Many repair men test for a grounded winding before using the growler, as a ground may invalidate other tests. With the growler current shut off, touch one test prod to the



shaft and the other to the commutator. If the series lamp lights, there is a ground in the armature and it will be necessary to unsolder all the leads from the commutator risers in order to test the winding and the commutator separately, thus determining which is grounded. Figure 18 illustrates this test being made.

Armatures from repulsion-induction A.C. motors also may be tested, but as they are fitted with various short-circuiting devices necessary to their operation, care must be taken that these are not bearing on the commutator during the tests just outlined. Such automatic contacts are usually fitted inside the hollow of the commutator, and should not touch the latter when the armature is at rest. As the motor gains speed, a centrifugal governor pushes them out to short-circuit the commutator at the same time the brushes are lifted off the latter, so that the motor continues to run as a squirrel-cage induction motor. Check the moving parts for dirt or pitted surfaces that might cause them to stick in operation, and see that the contacts cut in and out as they should.

Because of the relatively large amount of copper and iron in its core, the growler does not draw an excessive amount of current even with no armature in place. It may therefore be used for demagnetizing tools and watches. Simply move the article between the poles, allowing it to touch neither of them, and any permanent magnetism will disappear. The current draw on such an open magnetic circuit is about 4 amperes; with a small armature in place it is about 2½ amperes, and with the large one shown, it is only 2 amperes.

Small Rubber Band Keeps T-Square from Sliding

WHEN used on an inclined drawing board, a T-square is likely to slide down at inconvenient moments, causing delay and annoyance, and perhaps smudging wet ink on a finished drawing. This can be prevented by slipping a rubber band on the blade as shown. The additional friction is enough to keep the T-square from slipping, yet it can be moved up and down the board with a light touch of the fingers.—BRIAN A. LOVERIDGE.

ELECTROPLATING, PART 7 [ELECTRICAL]

Plating will not adhere to work that is not chemically clean, any trace of grease, tarnish, or oxides will result in a spotty deposit or one that will peel during subsequent handling. After washing the work with benzine to remove most of the grease film, it should be scrubbed in a hot solution of soapsuds fortified with a little washing soda.

The work may also be cleaned electrically by suspending it, as if it were the cathode, in an iron container which serves as the anode, with the following solution 1 gal. water, 3 oz. lye, and 5 oz. laundry soap chips. The brass rod from which the work is suspended must, of course, be insulated where it rests on the edges of the iron container.

No rheostat is required in the circuit, but use a double-pole, double-throw switch connected so as to reverse the current, which is used full strength. First throw the switch to make the work the cathode. A quantity of hydrogen bubbles will then be generated around the work. After three minutes, reverse the switch for *only five seconds* to dispel the hydrogen bubbles.

Do not handle the work with bare hands after it has been cleaned. Rinse with water. If this flows over the entire surface, without dry spots, it indicates that all grease has been removed. If the work appears not to have been entirely cleaned of oxides, it should be pickled before being transferred to the plating bath.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Last-Minute Gift Projects

DESIGNED FOR POPULAR SCIENCE BY ERNEST R. DEWALT

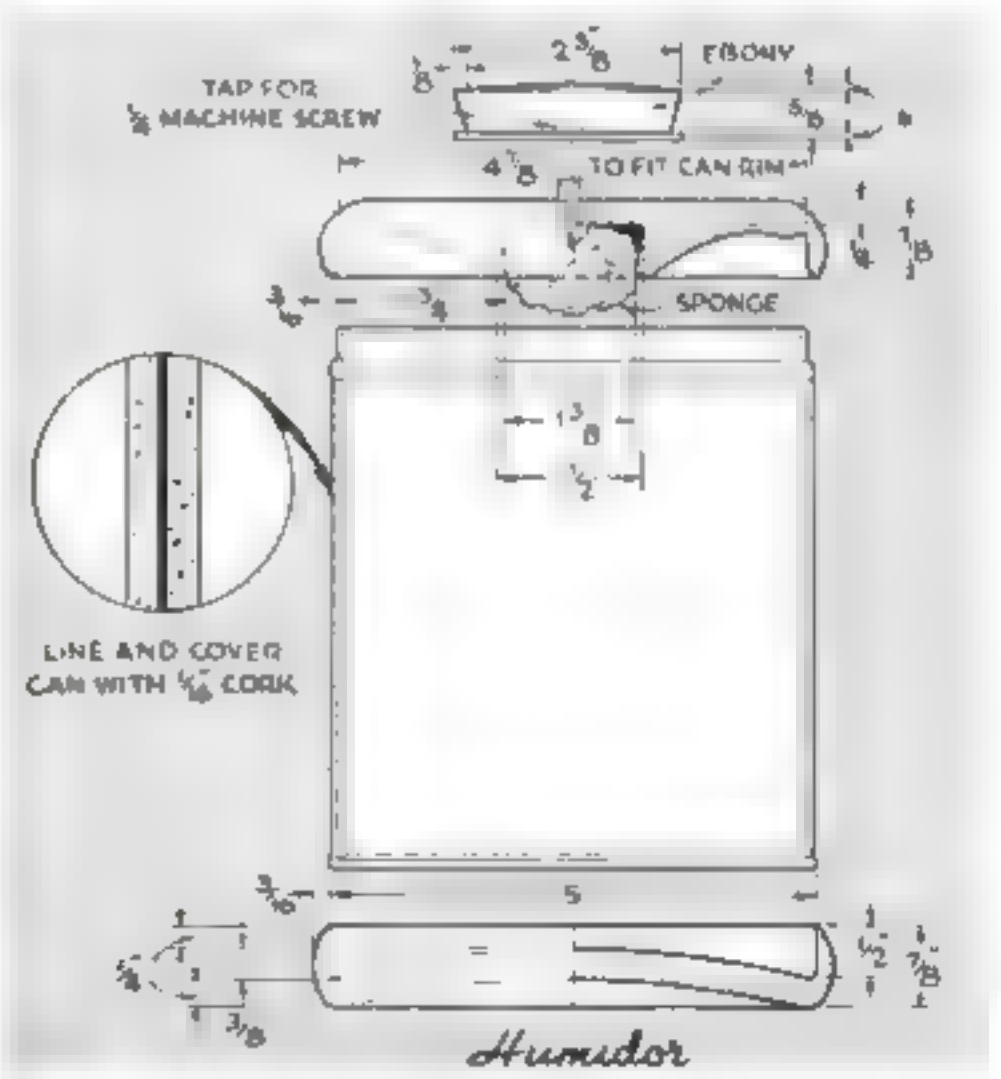
THERE may still be time to solve an urgent last-minute gift problem by making one of the attractive pieces shown on these pages.

TOBACCO HUMIDOR. Any pipe smoker will welcome this practical gift. Glue 1/16" sheet cork to the outside of a 1-lb. or ½-lb. tobacco can, holding it with rubber bands until dry. Line with cork, or Spanish-cedar veneer.

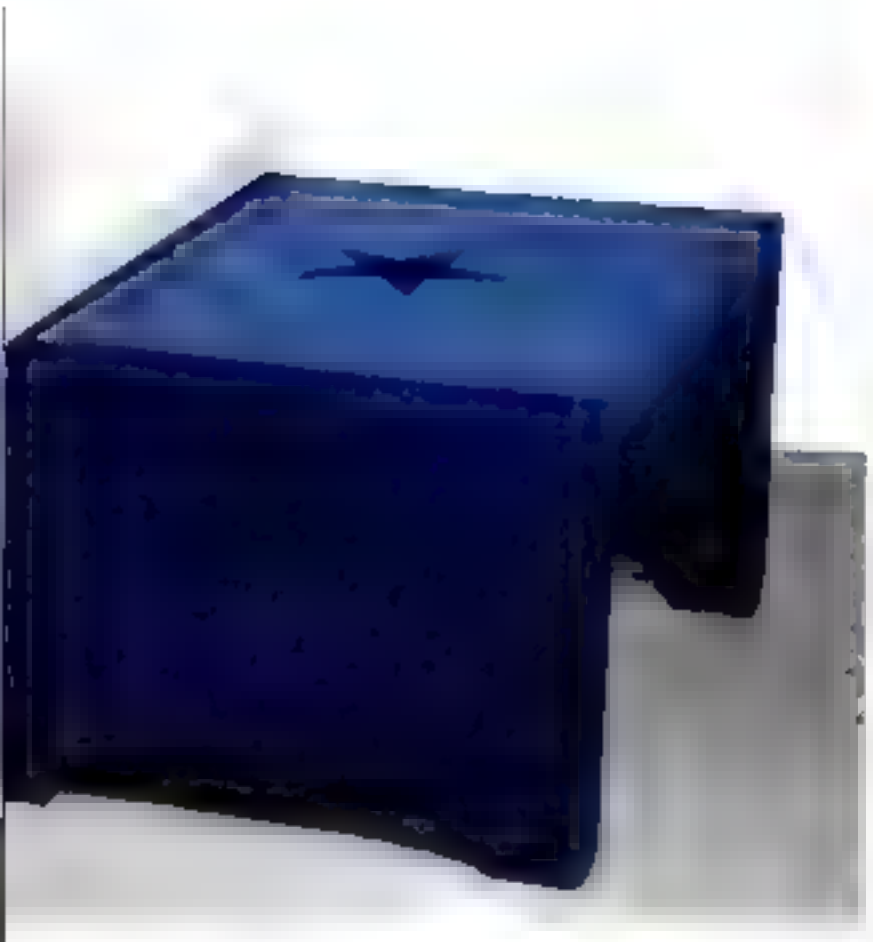
Base and cover are turned from ⅞" thick gumwood, walnut, or other stock to a snug fit on the can. A turned recess in the lid holds a small sponge. This hole is tapered slightly as shown, and the lid drilled for a ⅛" machine screw, which is threaded into a handle turned from ebony, if available, or black plastic.

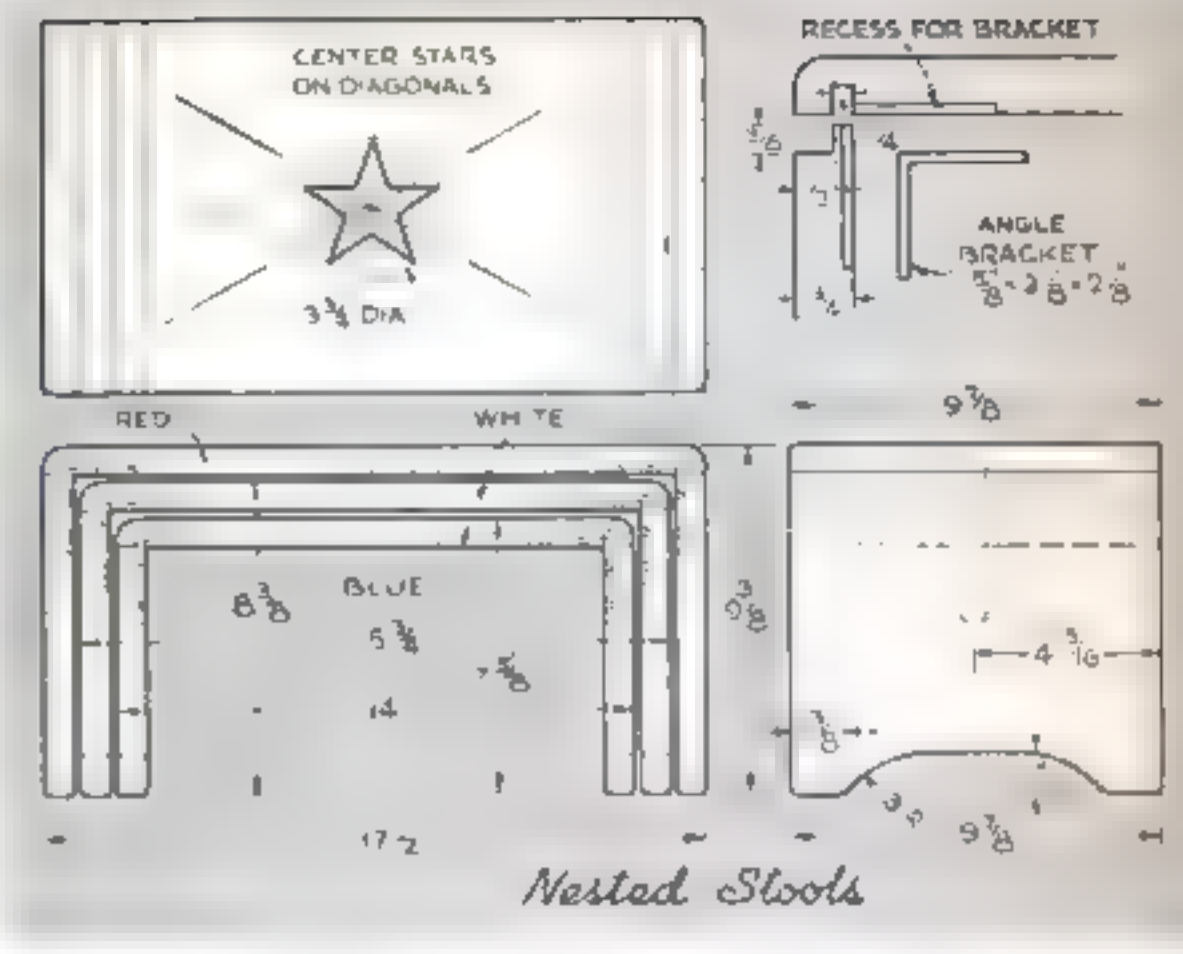
The wooden parts can be lathe-finished with three coats of clear lacquer, rubbed down with fine steel wool. The outer cork covering also is given a protective coat of clear lacquer, but the lining is not. Approximate time, 4 hours.

PLASTIC EASEL FRAME. Two pictures may be placed back to back in this novel tilted frame, which can be turned around for use above or below eye level. Rout parallel decorative grooves, 1/32" deep, on the four sides of ⅛" thick clear sheet plastic, using a sharp ⅛" bit and a guide fence. Cut a smaller sheet to fit inside the grooves. Drill both at once for metal-topped upholstery fasteners, to be secured with buttons turned



Humidor





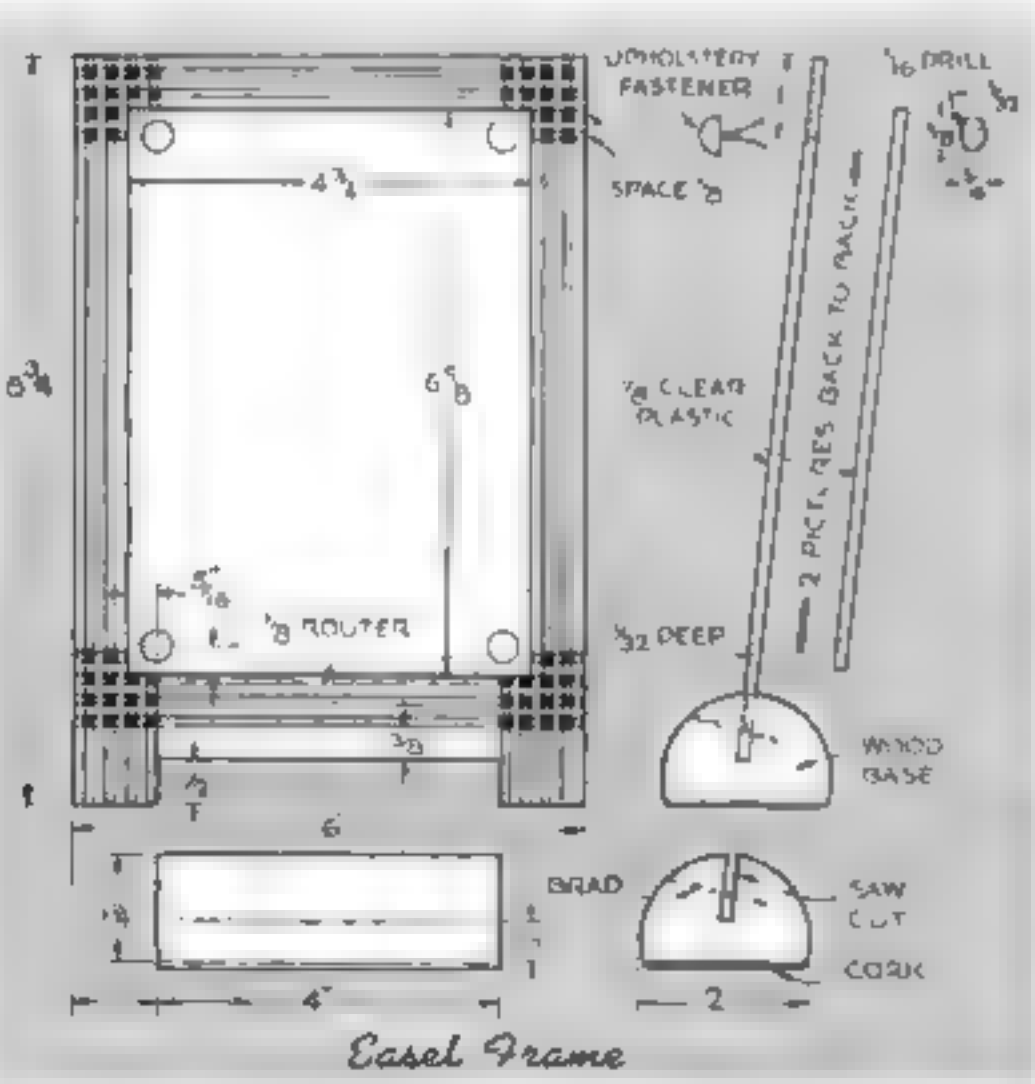
Nested Stools

from plastic rod. Turn a 4" length of hardwood to diameter and cut flat along one side. A ⅛" slot receives the plastic sheet. Shellac or lacquer the base, and fasten the parts with escutcheon pins in predrilled holes. Glue sheet cork to the bottom. Approximate time, 3½ hours.

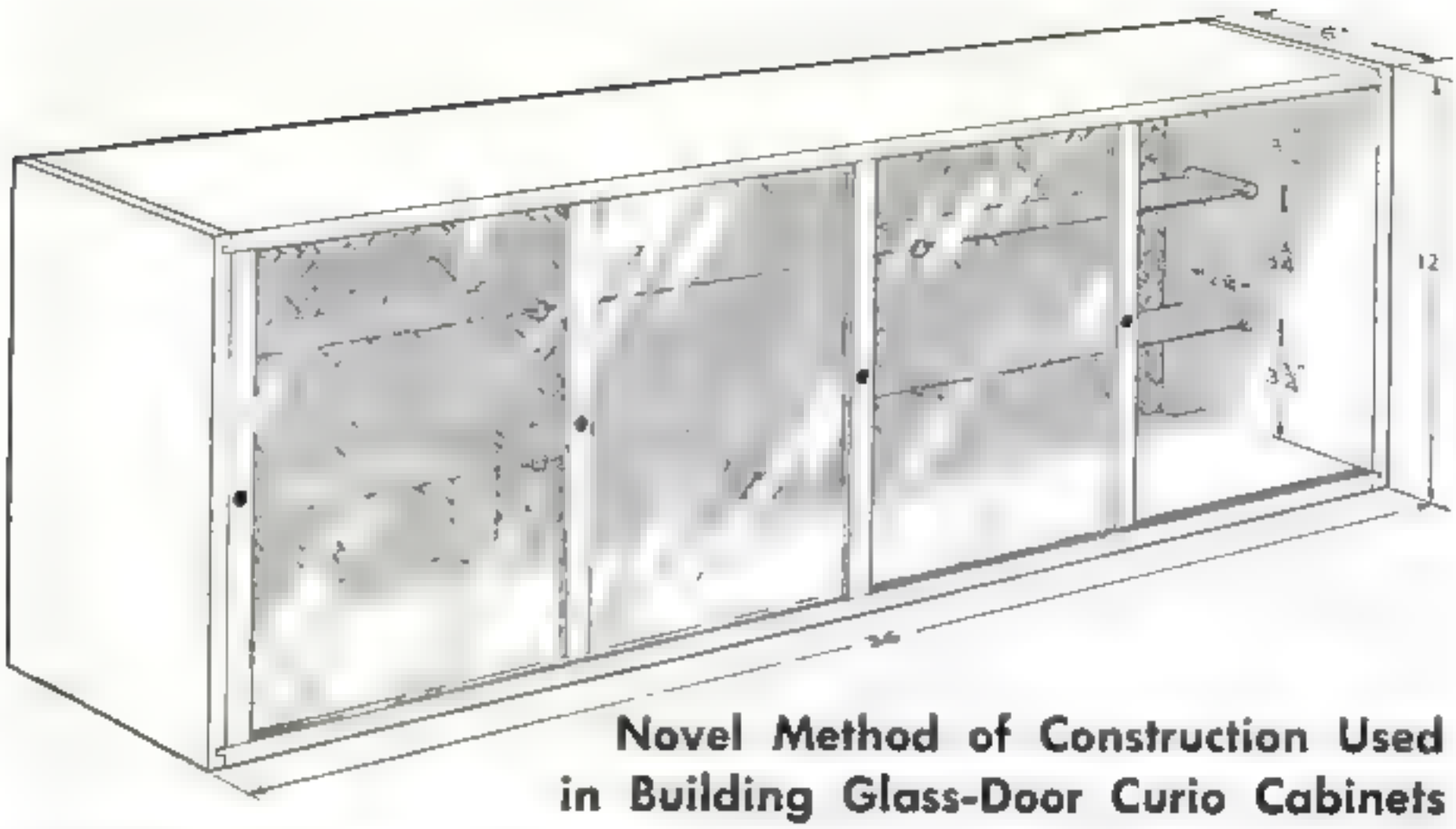
NESTED STOOLS. You'll hardly realize how many uses you can find for these stools. They can be finished in red, white, and blue for a game room or child's room, or a color appropriate for the living room. Pine is a suitable wood.

Rabbet the upper edge of each end ⅜" by ½", and dado the tops to fit. The cut-out stars are sawed accurately before assembly to line up when the stools are nested. To lay out the stars, mark off a circle into five equal parts and connect the points.

One iron angle bracket, sunk flush on the underside, reënforces each joint. Fit, round off the tops at both ends, then glue. Sand smooth. Apply a sealer coat of shellac or enamel undercoater, and two color coats. Approximate time, 3 hours for each stool or 7 hours for the set if all parts are cut at the same time.



Easel Frame



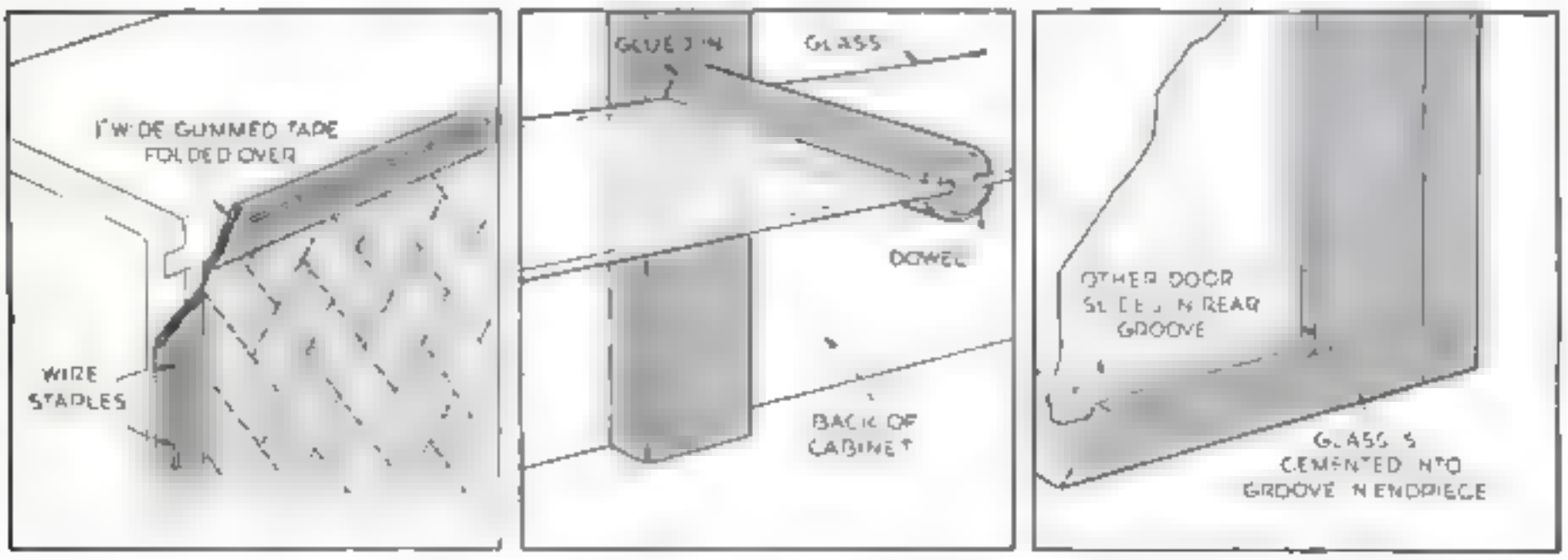
Novel Method of Construction Used in Building Glass-Door Curio Cabinets

AN INGENIOUS method of construction, adaptable for a variety of light display cases, takes this cabinet out of the ordinary. The finished piece provides an attractive method of showing small articles and of protecting them from dust. Almost any collector will find the one described here useful. For school exhibits and the like, a number can be hung in a line.

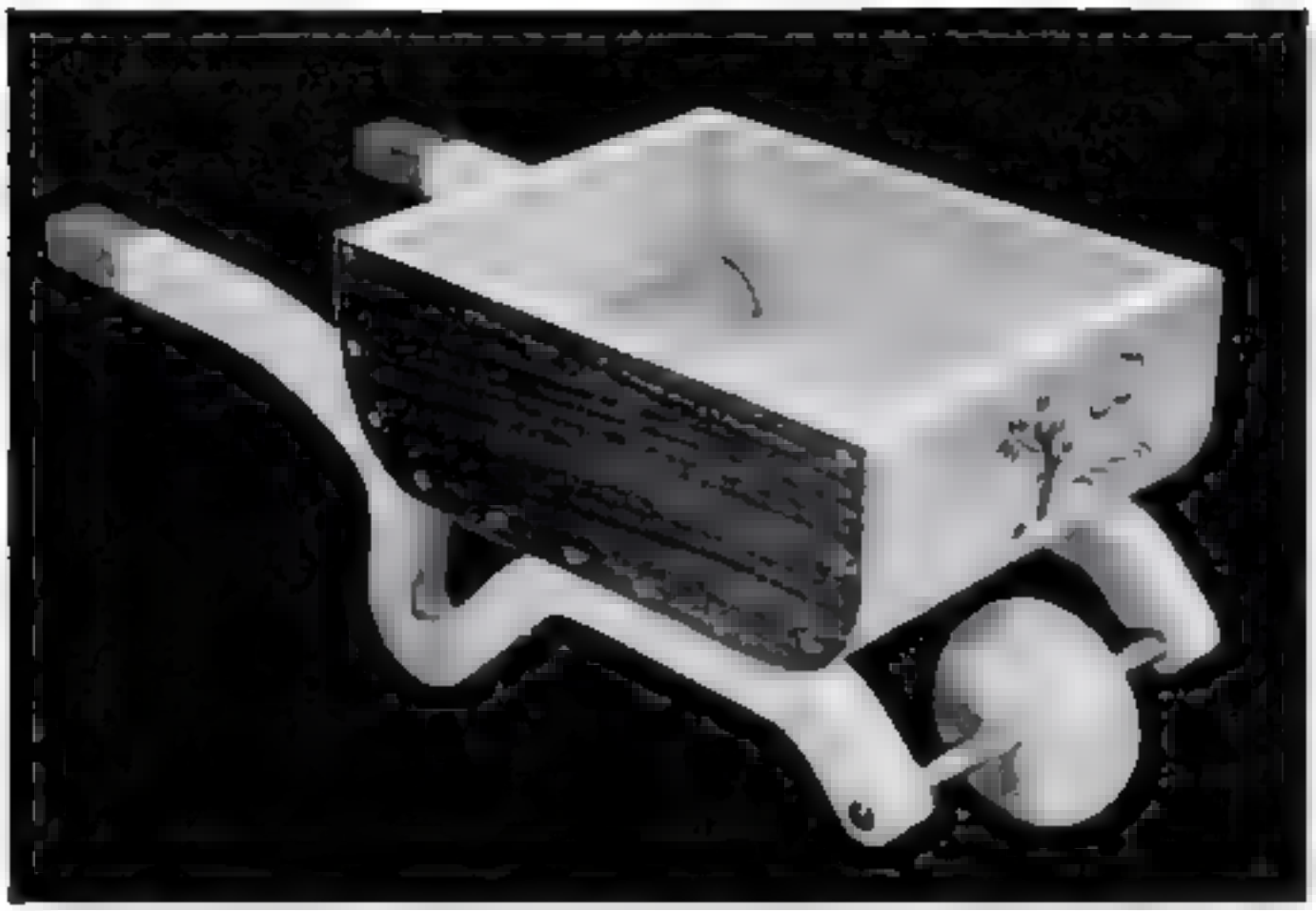
The glass shelves are supported by grooved lengths of dowel which have been glued into holes bored to fit in the reënforcing strips at the back of the case. The dowels are a departure from the customary brackets, and take a finish that blends well with the interior wood. The two sliding glass panels fit into tracks cut into the top and bottom of the case, each with a single pass over the circular saw, and each panel has two end pieces, slotted and cemented fast. The back is a piece of woven matting, such as is used in packing tea for shipment, with its edges reenforced with folded gummed tape. Plywood or hard board may also be used.

Pine ½" thick makes a light case. Top and bottom are end-rabbeted to leave a tongue ⅛" by ¼", and the sidepieces are grooved or dadoed. After the tracks are sawed and the grooved dowels glued into the reënforcing strips, the pieces are assembled, glued, and clamped. The glass panels are fitted into the case later by springing the top and bottom apart slightly at the middle, after which the grooved endpieces are cemented in place on the glass.

Neutral flat gray paint was used in the original model to stain the inside, then wiped off. The outside may be stained or tinted, then shellacked or waxed, or finished with enamel. Approximate time, 6 hours.—E. D.



Chinese matting is used for the back of the case, reënforced at the edges with gummed tape and attached to the frame with staples (the corners are, of course, square). The glass shelves fit in grooved dowels glued into the supporting uprights. The glass front panels slide in tracks cut on the circular saw



Finished in walnut and white, this ornamental wheelbarrow designed by Juan Oliver is both useful and attractive. Simple painted designs or decalcomanias will set off the two ends

Unique Little Wheelbarrow

HOLDS FRUITS, NUTS, OR A POTTED PLANT

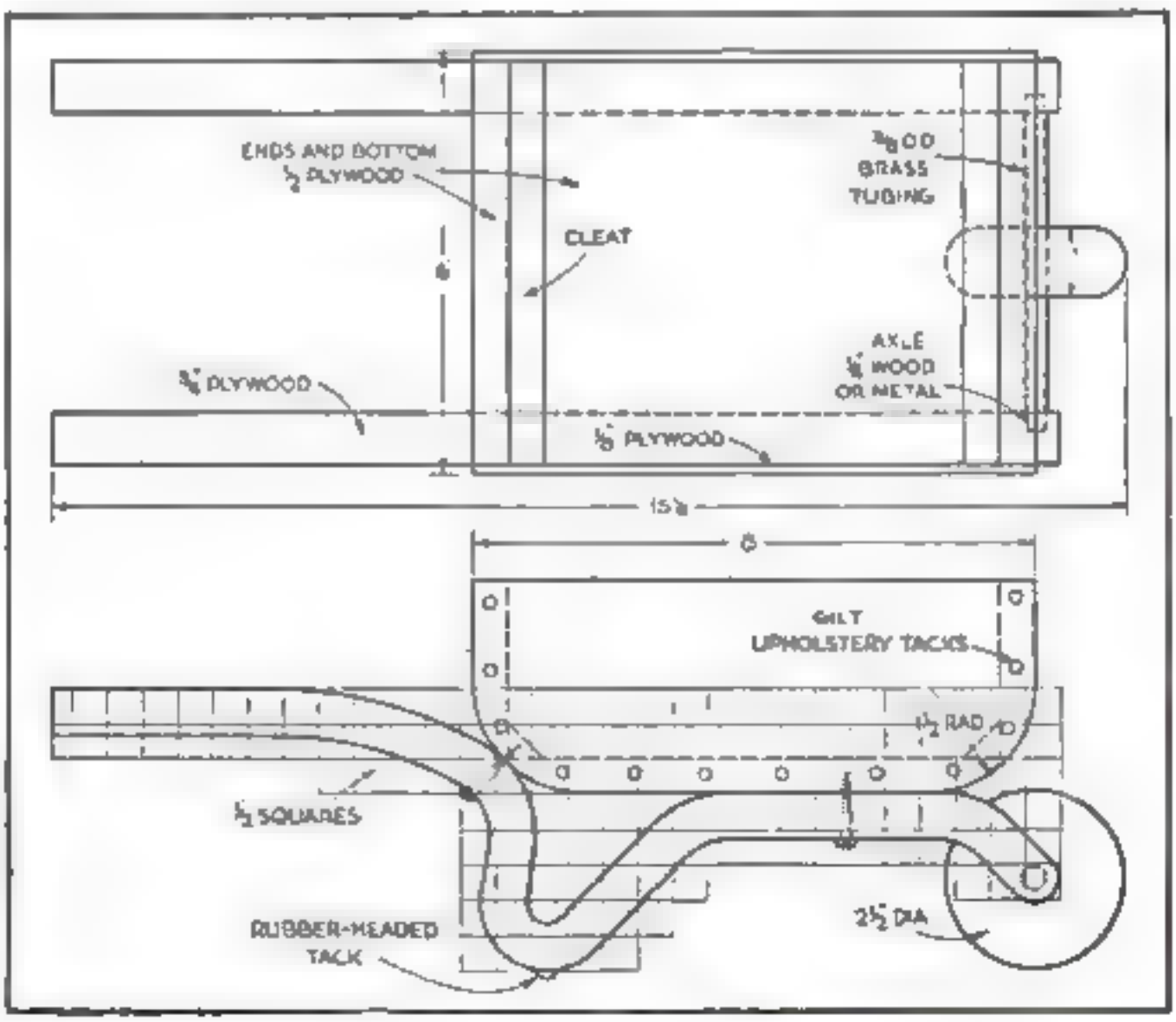
PILED high with nuts, candy, or fruit, this little wheelbarrow makes a novel table or mantel ornament, especially suitable for a Colonial or Cape Cod home. It can also be used to hold a potted plant and for other purposes. If there is a small child in the family, it will certainly be seized as a toy, so you had better make two wheelbarrows.

Band-saw the handles from ¾" plywood, as solid stock may break across the short grain. Either ½" plywood or other stock can be used for the bottom and ends, and ⅛" plywood or cigar-box wood for the sides.

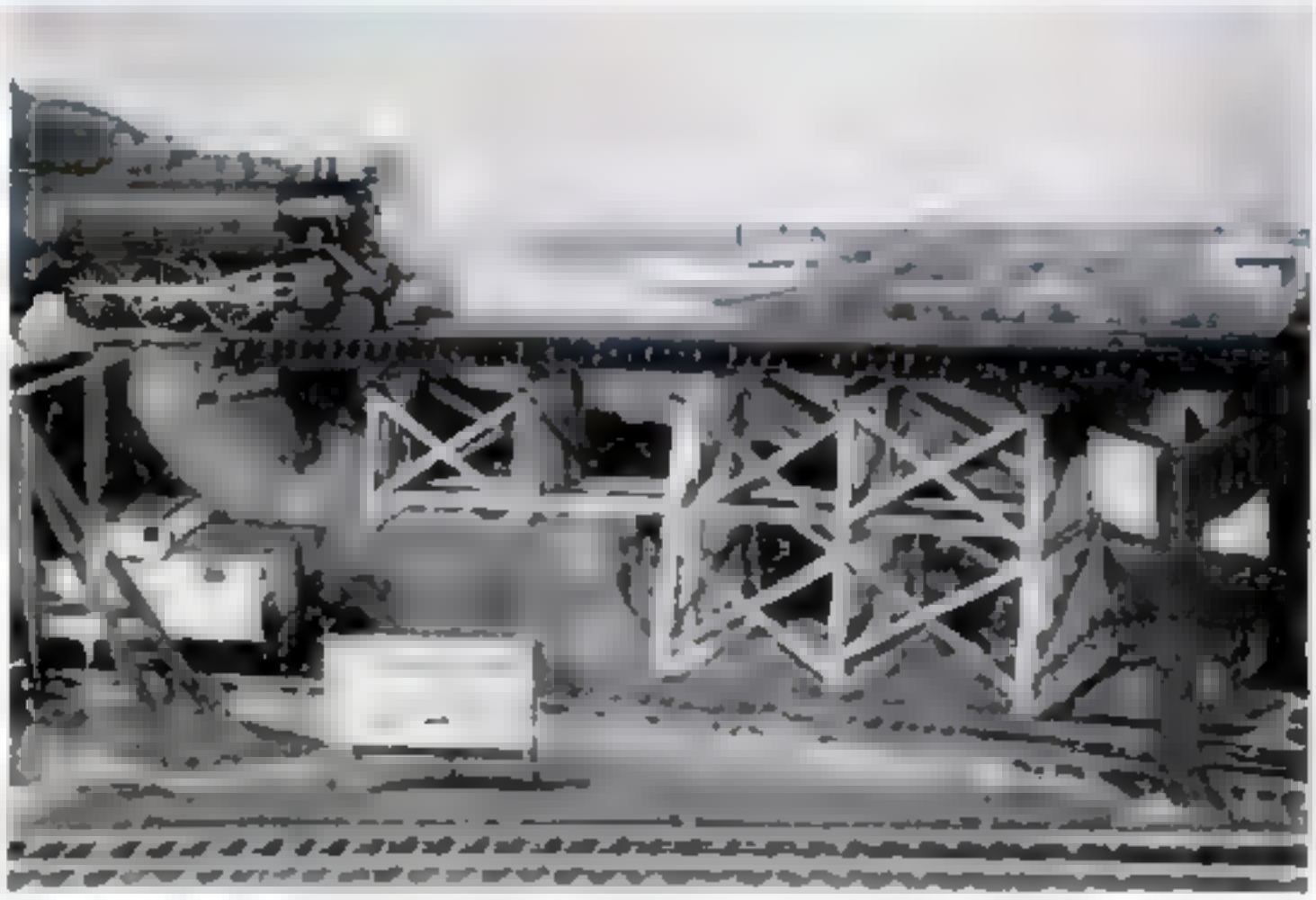
Build up the body first as a square box, reënforcing the end joints inside with quarter-round molding or triangular cleats. Use glue but no nails at these joints. Attach the sides with glue and gilt tacks. Round off the lower ends after the glue has set.

The wheel can be turned, or sawed from plywood, in which case the edges should be crowned on a sander. Drill a ¼" hole in it for the axle. Cut brass-tube spacers to keep the wheel centered. Drill the lower ends of the handle ¼" deep for the axle. Assemble by fastening the handles to the body with four wood screws.

In the original the sides, which were walnut veneer, were left natural color. Other parts were finished white, with a band of color on the handle grips.



MODEL-RAILWAY NOTES



AGAINST A PHOTO-MURAL BACKGROUND stands a trestle of the Manhattan Beach Rlwy. in a realistic setting. This model line, jointly owned by George Allen, of Yonkers, N. Y., and Ernest Huebner, of Richmond Hill, N. Y., is the successor to a real railroad, now defunct, which was the first to enter the city limits of present-day New York

By
DAVID MARSHALL

•

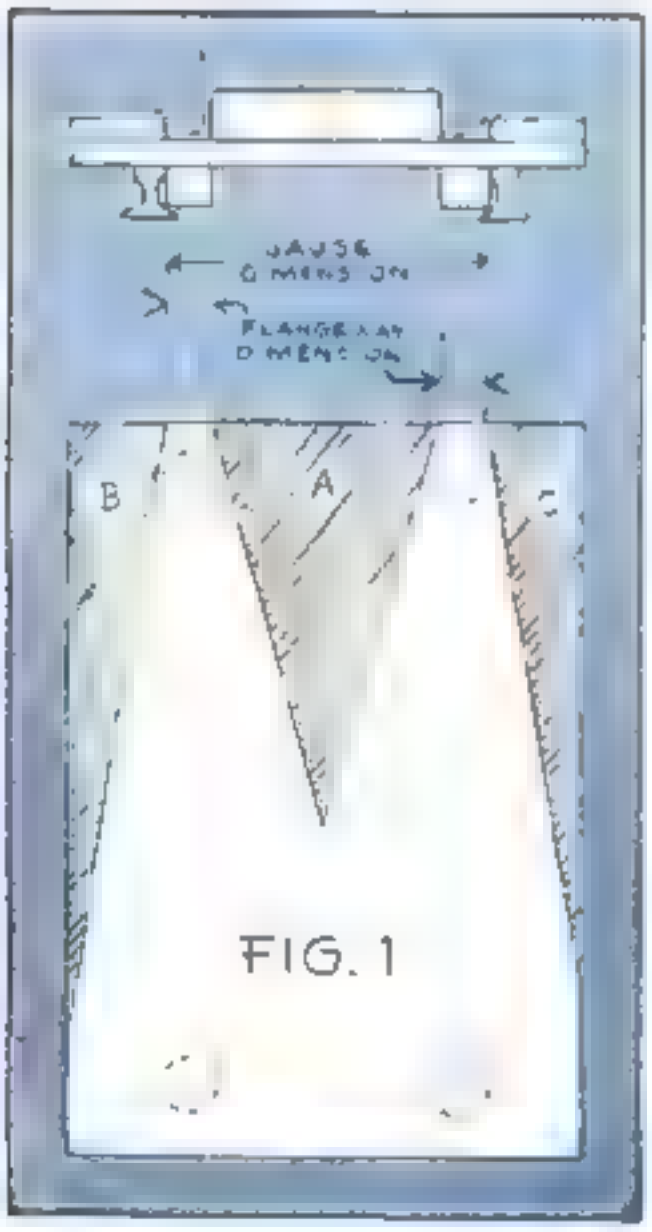


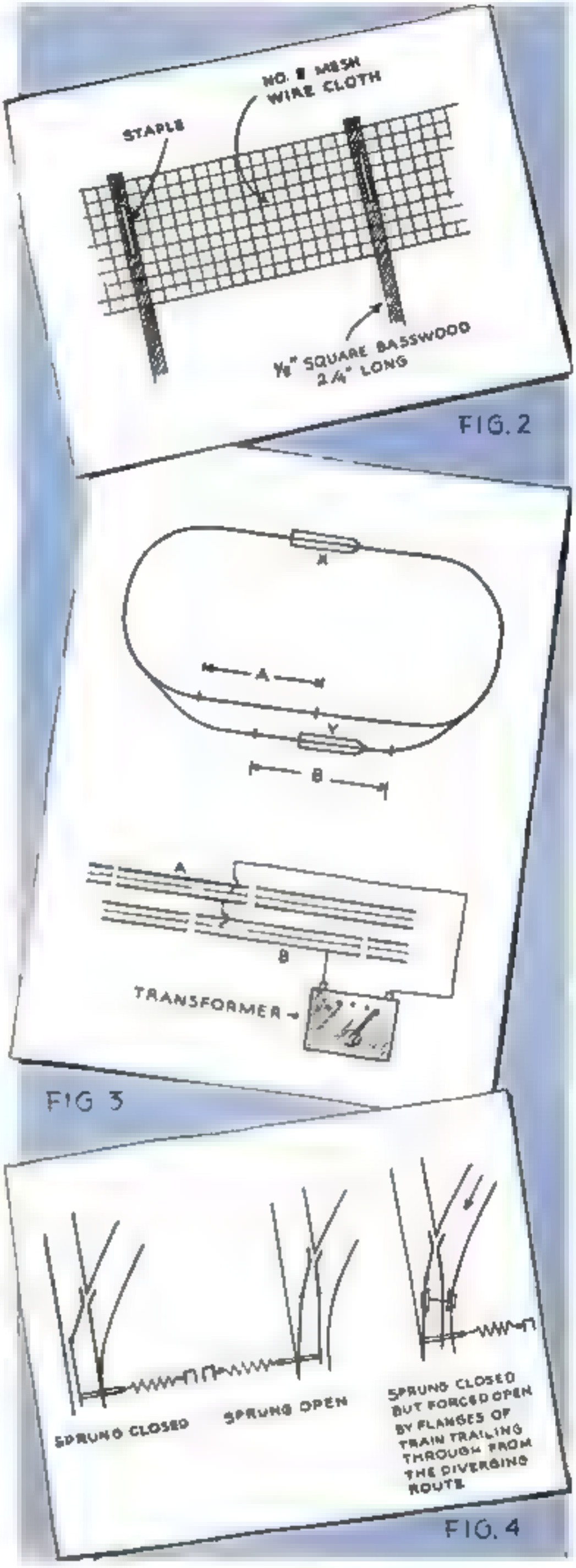
FIG. 1

HERE are six ideas I have found useful for improving model-railway operation. They are simple to execute, and will add enjoyment to running your system.

TRACK FUNNEL. This is the handiest of tools about a model pike, enabling you to place your cars and locomotives on the rails as fast as you can push them through. It locks in position across the rail tops; is therefore best made of a nonconductive material. Begin with a fiber sheet (Fig. 1) and rivet to the upper surface three triangles of sheet brass. *B* and *C* must be of a thickness less than the depth of your wheel flanges, so that the treads may ride freely over them; *A* should be of heavier stock. Their purpose is to guide the wheels to a position, at the business end of the funnel, whence they must fall squarely upon the rails. Thus, at their nearest points, *B* and *C* are separated by the precise distance that separates the *inside faces* of your running rails, while *A* must have a base just broad enough to reduce the flangeways to whatever is standard in your gauge. The four studs on the lower side of the fiber sheet, which are easily built up of small metal washers, engage the rails. They must be narrow to miss contact with an inside third rail. Being round, they permit the use of this funnel on straight or curved sections of tinplate or model track.

WIRE FENCING. Along the model right-of-way, fencing supplies that authentic touch of realism; saves many a derailed locomotive from tumbling to the floor; and sets up a most desirable illusion of distance. By confining the track, it makes it look narrower, and therefore longer. For O gauge, No. 8 mesh wire cloth is the stuff (Fig.

2); woven eight strands to the inch, this is almost a scale model of that real fencing in which the lines and stays are set 6" apart. Cut your strips ten strands wide for a 5' fence, and file the edges smooth, so that none of the transverse wires is left protruding. Posts are normally 9' apart, so you'll need one for every 18 vertical stays. The most practical and best looking are of basswood, ⅛" square by 2¼" long. You can attach them wholesale with a stapler, just as you would staple wire screening to screen doors. Set each post so that one end rises 1/16" above the top line. The other end sets in your plaster-work "earth," or, with corners trimmed, fits into a ⅛" hole drilled in the table top. For a nonpermanent layout, strips of trellis make excellent foundations for sectionalized fencing. For HO and OO pikes, No. 12 mesh wire screening is indicated; it is sweat-soldered to No. 16 wire "posts."



AUTOMATIC RESTARTING. Tinplate or model trains moving in opposite directions over a single-tracked line can be made, by the wiring device shown in Fig. 3, to stop and wait for one another at passing sidings, and then to restart automatically as each "meet" is completed. In a complex layout, the principle can be applied to many sidings; can be relied on to take care of the trains out on the road, while you give your attention to that complicated set of switches outside your main terminal. *A* and *B* are track sections wholly insulated from the rest of the system; insulated as to third-rail and both of the running rails. But they are connected to each other in a power circuit which is normally twice broken. Thus, when train *Y* arrives over *B*, she stops because of power failure. When train *X* arrives over *A*, however, the circuit is completed, and *Y* resumes her journey. Actually *X* and *Y* are now hooked up in series, but before *X* can traverse the entire length of *A*, *Y* will have cleared *B*, thus breaking the circuit again and causing *X* to stop.

SPRUNG SWITCHES. In trailing crossovers and every type of double-end siding, including the type above dealt with, sprung switches (Fig. 4) are indicated; and these can be tinplate as well as model jobs. You simply remove the control lever in favor of a spring that has just enough pull to

keep the points in one position, yet will allow them to be pushed aside by the flanges of a train trailing through from the rear. You determine in advance whether the switch is to be normally closed or normally open. Thereafter it always offers the same route, either straight or diverging, to all trains that face into it. From the rear, however, trains can trail through from either route. Thus every train will invariably take the right-hand track on entering a siding; and on leaving, will push its way through the switch. Where these are employed for trailing crossovers, the switches are sprung open; thus all normal traffic pushes through, and every wrong-track operation is automatically transferred to the right-hand track.

PROTECTED CROSSINGS. Crossings are protected, on the grown-up railroads, by signals and automatic train controls which are electrically so interconnected with one another—"interlocked" is the technical word—as to make it impossible for the signals to *clear* both routes at the same time, and almost impossible for two trains actually to meet at the center. In model railroading the same end is achieved by wiring your crossing in the manner shown in Fig. 5. The secret lies in the use of the double-throw knife switch. *M*, *N*, *X*, and *Y* are all insulated third-rail sections on the crossing approaches. When the blade is thrown left, both *M* and *N* are energized, and the route of which they form parts is both "established" and protected against any train movement along the conflicting route, since *X* and *Y* are necessarily "dead." The other route can be protected in its turn.

AUTOMATIC BUFFER SIGNAL. The dead-end track that curls out of sight beyond a hill, or loses itself in a dummy tunnel, can be a very important adjunct of your pike. Trouble is, though, that when you back a train onto such a track, you work pretty much by blind reckoning, and half the time jam the hidden bumper hard enough to derail cars in the most inaccessible corner of your layout. This can be avoided by insulating the last 12" or 14" of running rail, and passing a wire from this rail through an electric light bulb to the third rail (Fig. 6). The bulb is at your control panel, and is normally not lighted. But the instant your caboose reaches the insulated rail section, the wheels close the gap between this and the opposite running rail, thus completing the circuit which causes the light to glow—your signal that the train has backed up as far as it can safely go. We assume, of course, that the running rails are mutually insulated.

FIG. 5

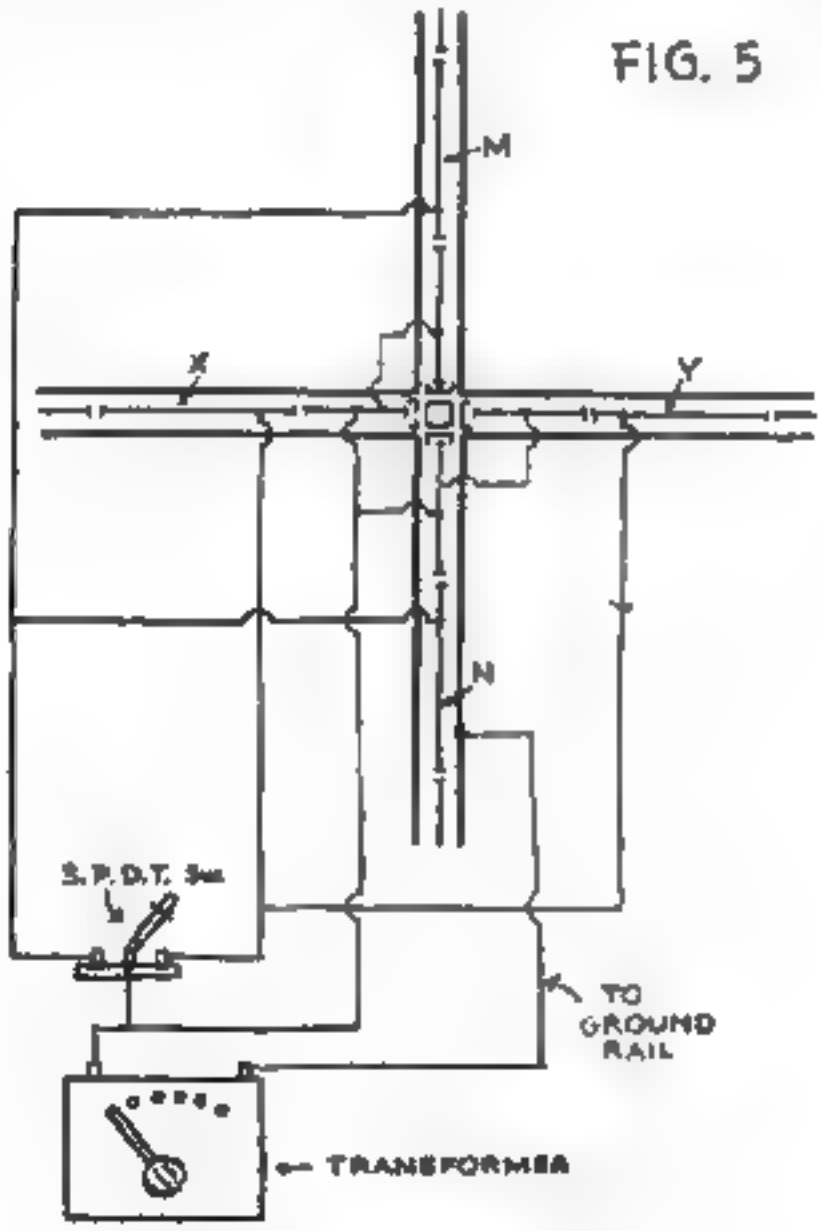
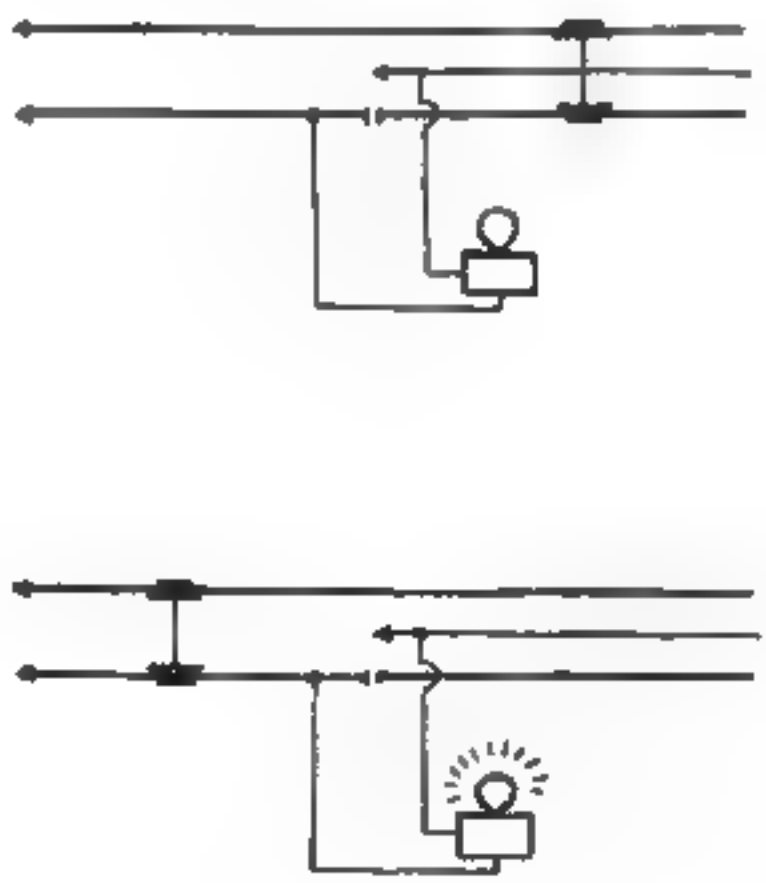


FIG. 6



Gear Converted into Indexing Table for Lathe

Above, milling a hexagon head on a special bolt. Such round stock is clamped in a split bushing

Parts of the dividing table, some of the split bushings, and, at right, samples of milled work

The table assembly is clamped to an angle plate for milling out the slots

Turn hub to fit lathe cross slide. At right above, collar and indexing pin

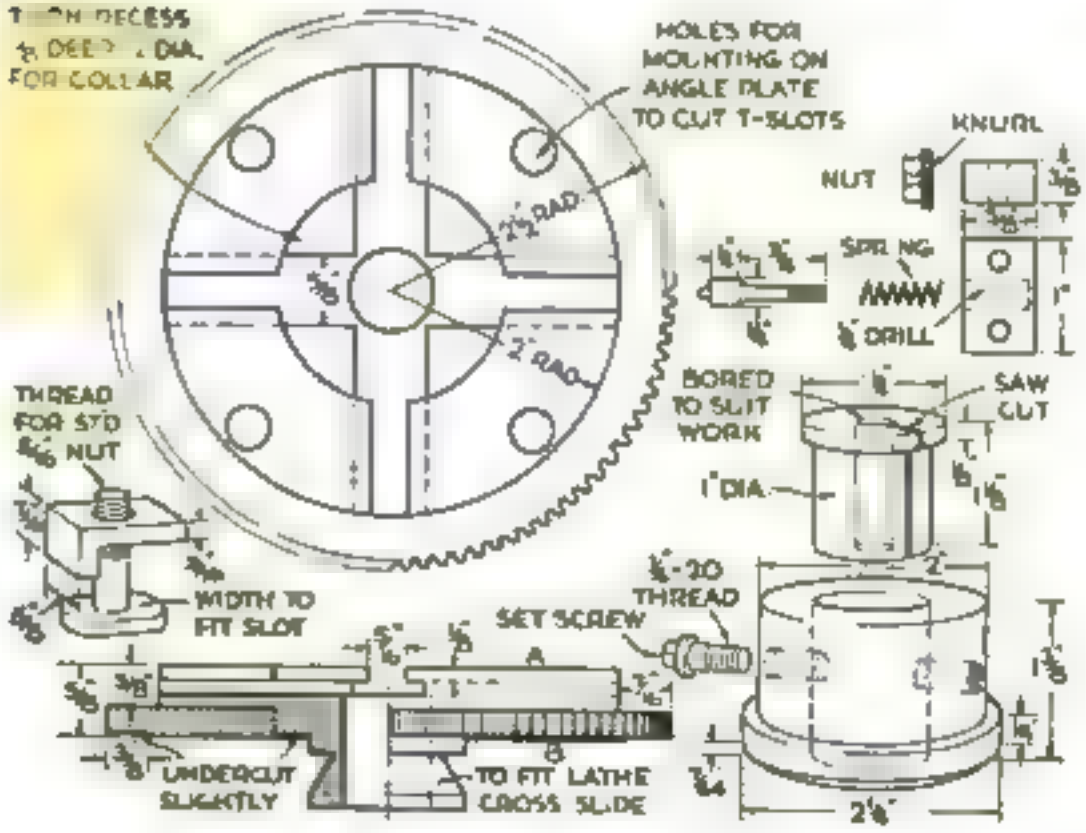
BY MEANS of the homemade dividing table illustrated, you can increase the usefulness of your lathe for making special bolts and nuts, fluting short end mills, counterbores, or hollow mills, drilling accurately spaced holes in round stock, and other work that involves indexing

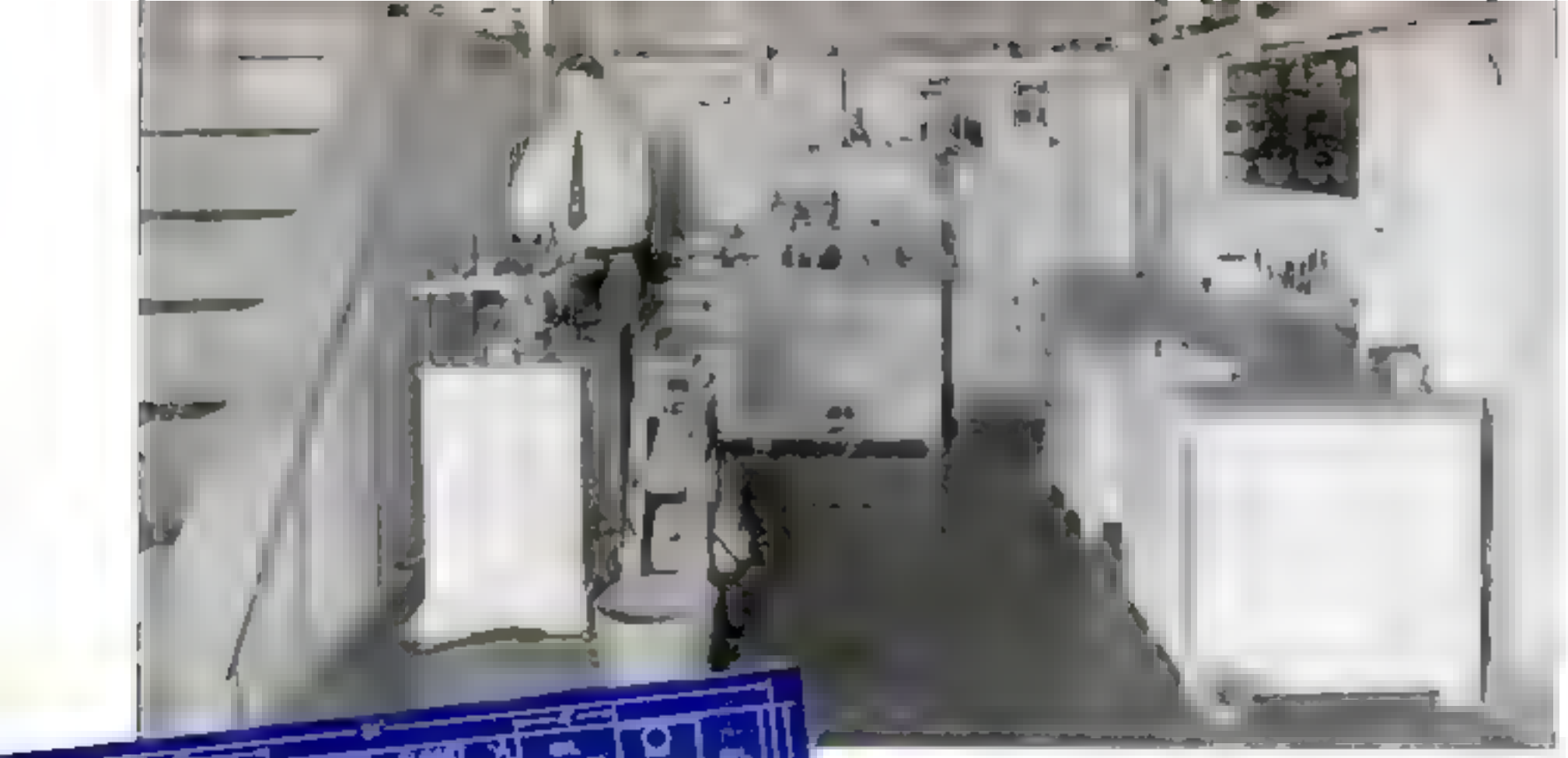
From 1¼" thick cold-rolled steel, turn the circular table to shape as shown in the drawing to fit the lathe cross slide, and provide a flanged shoulder for the toothed ring. A standard 120-tooth steel gear 5" in diameter forms the indexing head. Bore out the hub to a very tight fit on the table flange, heat the ring slowly and evenly, and shrink it in place. Pin it fast as well, if it is to be case-hardened later. Check carefully to see that surfaces *A* and *B* are parallel.

Four holes are drilled in this table assembly so that it may be mounted on an angle plate for cutting the T-slots. These can be started with a 5/16" end mill and finished with a ⅝" diameter by ⅛" Woodruff keyway cutter as shown in one of the photographs.

Large work is held to the table by small clips and clamping bolts that engage the slots. Round work is chucked in special split bushings that fit into a heavy collar, which in turn is clamped to the table by the bolts previously mentioned. Turn both collar and bushings accurately to size from steel, and harden them if possible. The bushings must be a close fit in the collar, and should be bored out exactly to size for various diameters of work, or else threaded to suit. Split each bushing with a hack saw as shown.

The head of a machine bolt may be shaped to form the indexing pin, which should be a close fit in the mounting block. Screw the latter to the cross slide.—JOHN STEINLEIN.





Behind many of these bright, neat panels are stored tools and lumber for a busy home workshop. The test board above the large bench is for electrical repairs

Shop with Concealed Closets Stays Neat as a Pin

How would you like to have a home workshop like this? When these photos were sent in by John A. Mahon, of Philadelphia, we had only one criticism to make . . . that the shop looked too good to work in.

"I quite agree with you," Mahon replied, "but the photos were taken when the shop was in one of its holiday moods. When the sawdust starts flying, it is quite different!"

The shop occupies 14' by 31' in the basement of Mahon's home. The paneling has the appearance of a solid wall, but conceals a series of closets and lumber storage space. The panels are 2' wide by 6' high, and those in front of closets are removable.

The closets are 10" deep. Some contain drawers for spare parts and equipment; one has shelves for paint; one a horizontal board with holes for stocks and dies, sledge hammers, large bar clamps, long chisels, and other such equipment. Machines for large work are movable. The circular-saw stand contains a sawdust bin. Over one bench is an electrical test board.

The color scheme in the shop is well suited for conserving light, the ceiling being a pale, bluish green, the walls and benches ivory, the panel strips jade green, and the crown molding peach. The floor is red. Benches are trimmed with Chinese red and aluminum and chromium molding, and the machines are painted light gray.

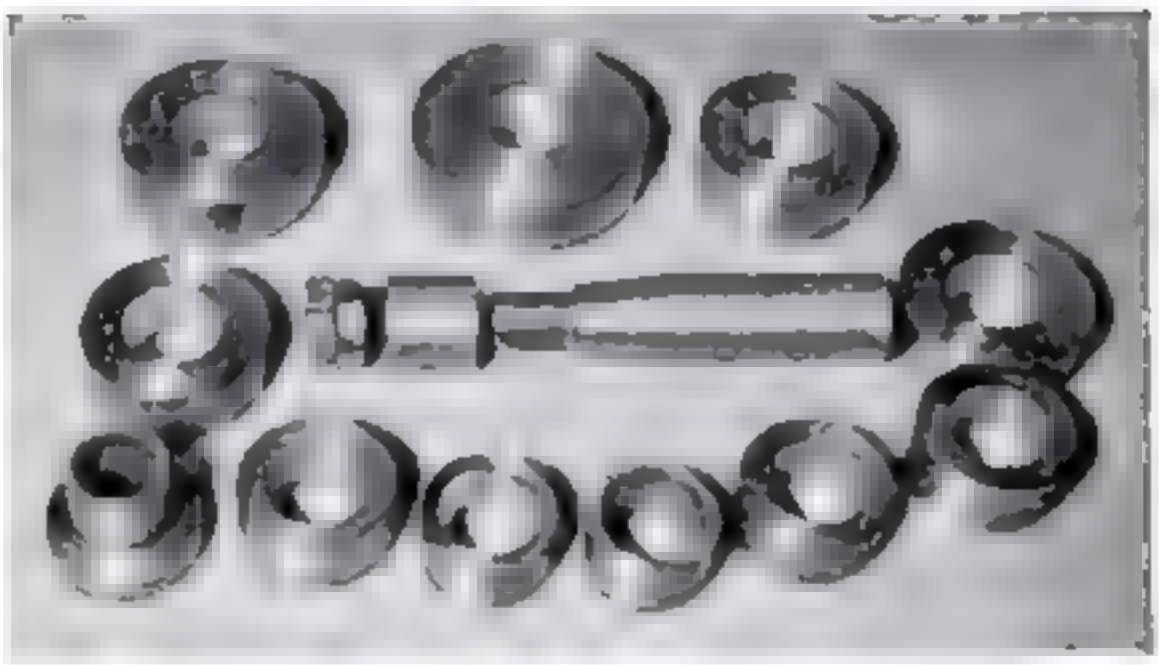
Light is conserved by the colors employed. Note the fluorescent fixture over the screw-cutting lathe

FLOATING COLLARS

PREVENT BURNING WORK ON WOOD SHAPER

WHEN a collar is used on a shaper spindle to guide the edge of the work or a wooden pattern, friction against the collar is likely to burn the stock or cause enough wear on patterns eventually to change their dimensions. On long runs, too, the heat produced causes pitch from the wood to be deposited on the collars, making it necessary to stop work frequently and clean this off.

If a metal-turning lathe is available, it is possible to make a set of floating collars that will eliminate all these difficulties. As shown in Fig. 1, the collar proper is free to rotate on a bushing that is locked fast on the spindle. This bushing is turned from 1" round steel to the dimensions give in Fig. 2. Its outer bearing surface above the shoulder is 1/16" wider than the collars, and should be well finished to reduce friction. The bushing may be hardened if facilities for doing work of this kind are available.



Several collars, the expanding mandrel on which they are turned, and, at lower left of the photo, the bushing on which they fit

A finished collar, and another clamped in place on the expanding mandrel, ready to be turned. Mount the mandrel between centers and drive it with a dog

The holes in the collars are drilled out as smoothly as possible to 23/32" and then mounted on a special expanding mandrel, which can be made on the lathe without difficulty as shown in Fig. 3. The mandrel is necessary in order to turn the collars true and to size on the outside. Extra collars can be made from steel rod or scrap to fit the cutters on hand.—HAROLD W. STANTON.

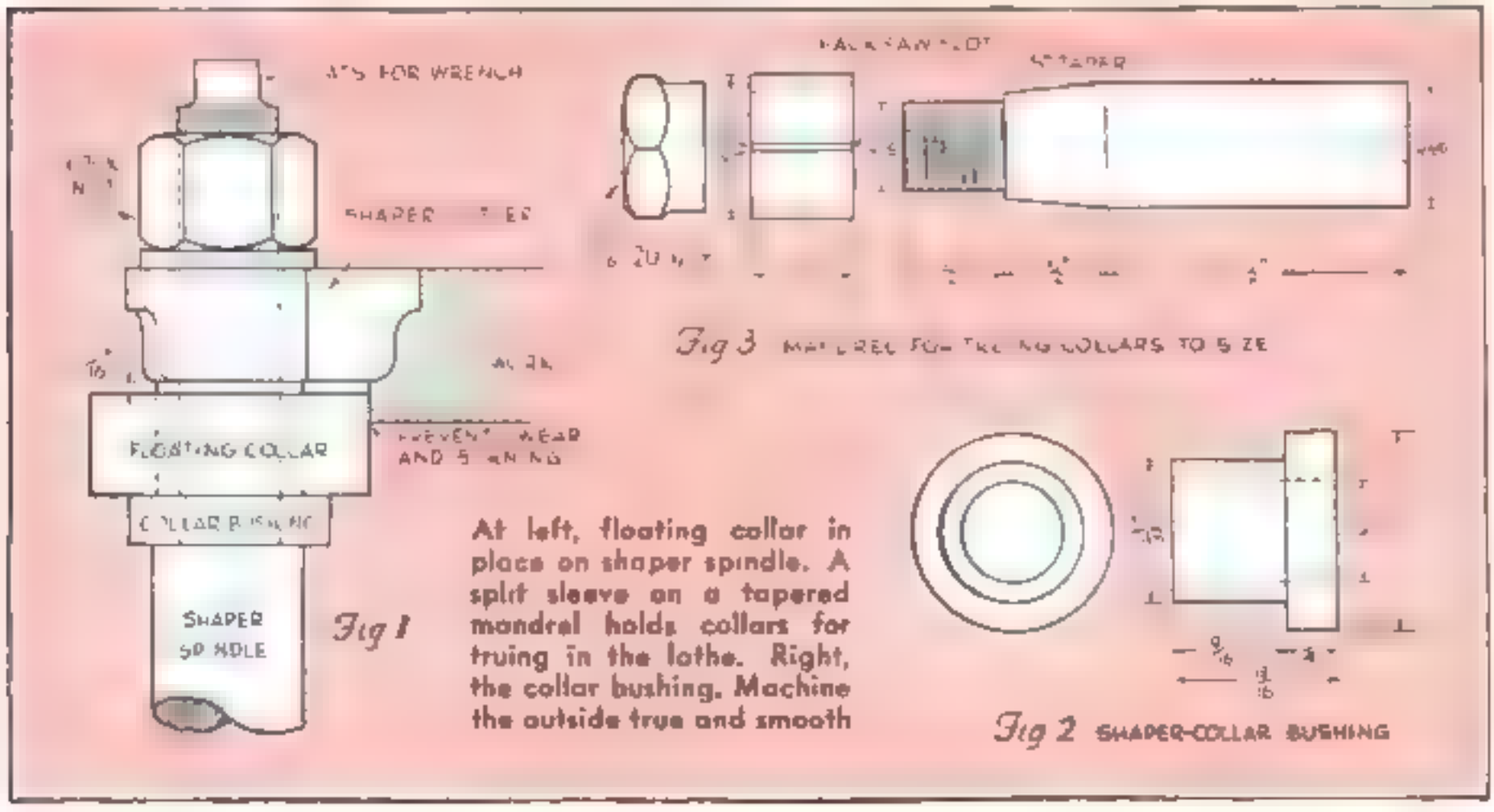


Fig 1

At left, floating collar in place on shaper spindle. A split sleeve on a tapered mandrel holds collars for truing in the lathe. Right, the collar bushing. Machine the outside true and smooth

Fig 3

Fig 2 SHAPER-COLLAR BUSHING

This space-saving rack keeps welding rods of various types and thicknesses in convenient separate groups

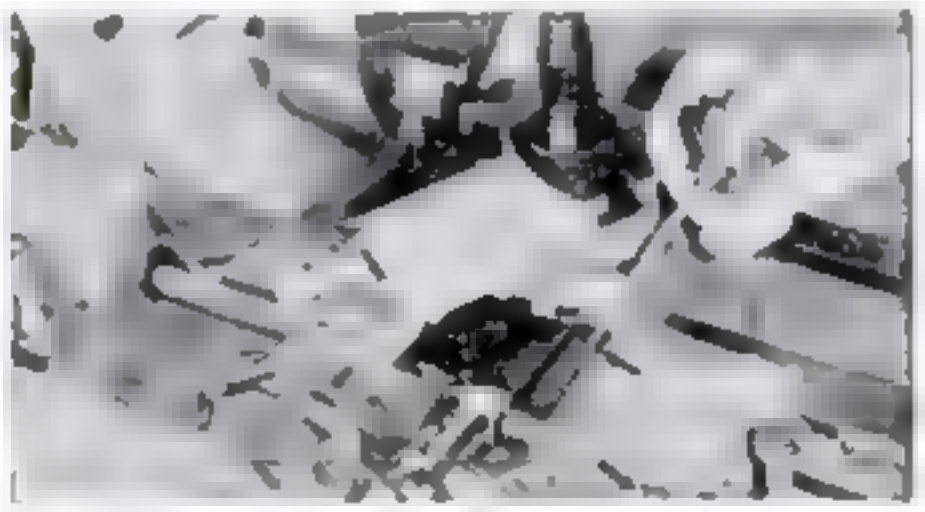
Rack for Welding Equipment Made from Scrap Pipe

SECTIONS of scrap 2" pipe, welded together, will serve as a convenient wall rack for holding welding rods and equipment, especially where space is limited. The cutting torch may be stored on two L-shaped hooks bent from rod and welded into the seam between two pipes. Goggles and other accessories may be hung on similar hooks. If the pipe is cut to various lengths and welded together so that the rack tapers from top to bottom, as shown, short scrap rods can be kept handy in the lowest pipe.

Colored Markers Remind Mechanic to Oil Lathe Regularly

THE importance of regular and complete oiling of a metal-turning lathe cannot be overemphasized. To insure covering all the points marked on the oiling chart, these can be marked on the lathe itself as shown. Red markings are used to indicate oiling every time the lathe is used, and blue or yellow where oiling is necessary only at intervals. Circular gummed notebook reënforcements, painted to suit, make good markers. Painted arrows indicate flat surfaces to be oiled regularly.—RICHARD HANSCOM.

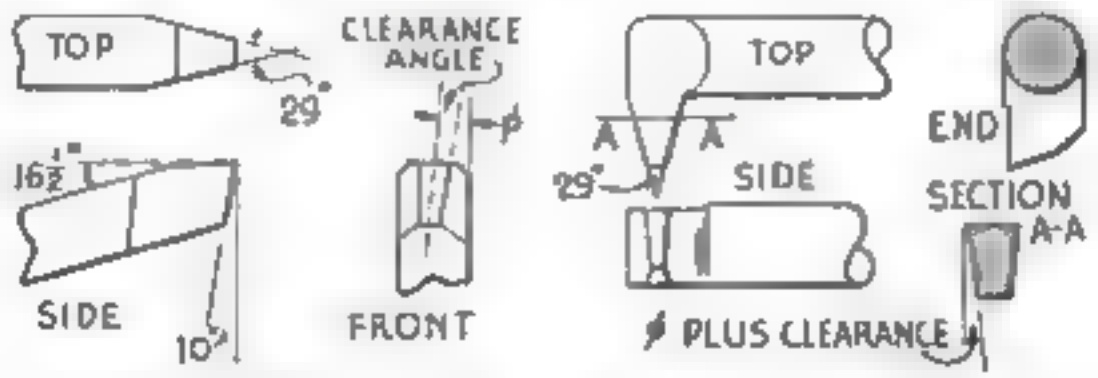
Pierced disks of different colors mark oil holes



Other lubrication points are indicated by arrows

TOOL BITS FOR CUTTING ACME THREADS [*LATHE WORK—24*]

Use an Acme thread gauge to check the form of the tools during grinding. The bit is set at 90 deg. to the work and should project as little as possible beyond the tool holder. Take light cuts of not more than 0.010", feeding the tool with the cross feed. Apply cutting oil generously.



TOOL FOR CUTTING EXTERNAL ACME THREAD

TOOL FOR CUTTING INTERNAL ACME THREAD

ϕ = HELIX ANGLE

POPULAR SCIENCE MONTHLY SHOP DATA FILE

MACHINISTS FOR DEFENSE

Used for many jobs in the shop, these punches, left to right are for spacing centers, laying out duplicate work, scribing circles, driving, and pricking

Making Punches Gives Beginner Practice in Elementary Machine-Shop Work

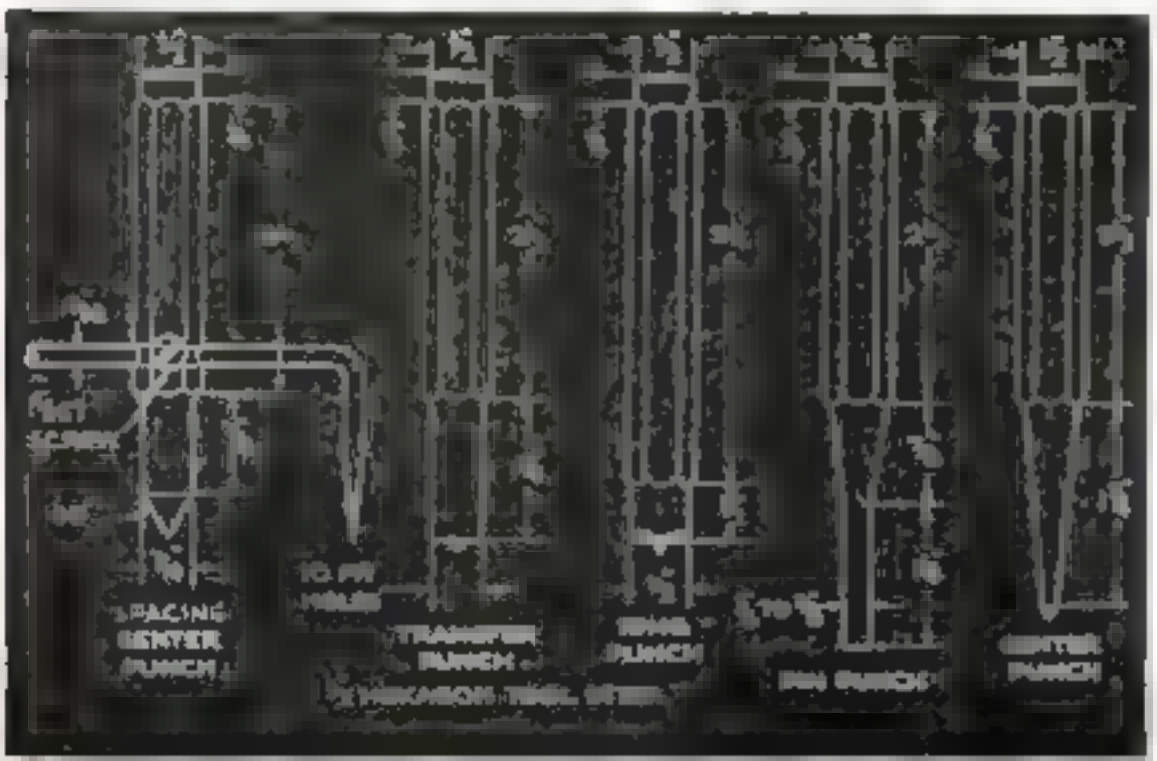
ALL the punches in Fig. 1 were made from a hexagon bar of tool steel. The center punch at the left has a simple spacing attachment, indispensable for rapid and accurate spacing of center distances, laying off rows of holes to be drilled, cutting out disks and the like. Its 60-deg. point is turned while chucked (Fig. 2), the hole for the spacing rod drilled (Fig. 3), and an intersecting hole drilled and tapped for a set screw. The point is then hardened and drawn. The spacing bar is made from drill rod, pointed and bent to shape

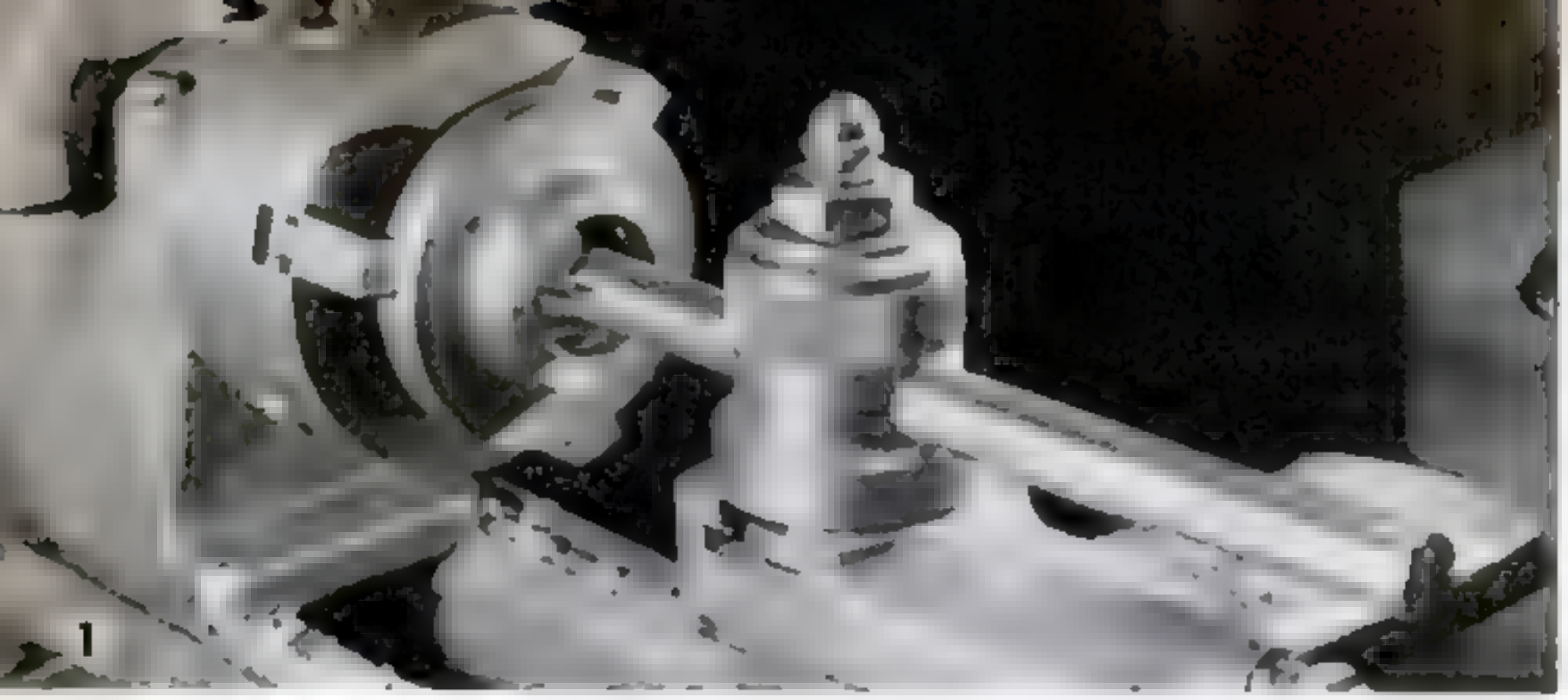
The punch in Fig. 4 is used for transferring the center of holes already drilled. The cylindrical section, turned to a snug fit in the drilled holes, accurately centers the point for laying out duplicate work. It should be made to fit the work at hand, and the point hardened

Where holes are laid out for drilling, it is customary to scribe a circle with dividers around the punch mark to check the travel of the drill. If a number are to be scribed, the punch in Fig. 5 will save time. The point is placed in the punch mark, and a blow struck with a hammer to mark the circle. Any shift of the drill from center can be detected by the circle

Drive-pin punches (Fig. 1, second from right) are handy for driving cotter pins and rivets out of holes, and should be made in a variety of sizes, such as $\frac{1}{8}$", 3 16 , $\frac{1}{4}$", 5 16", and $\frac{3}{8}$", hardened on the tips, and finally polished

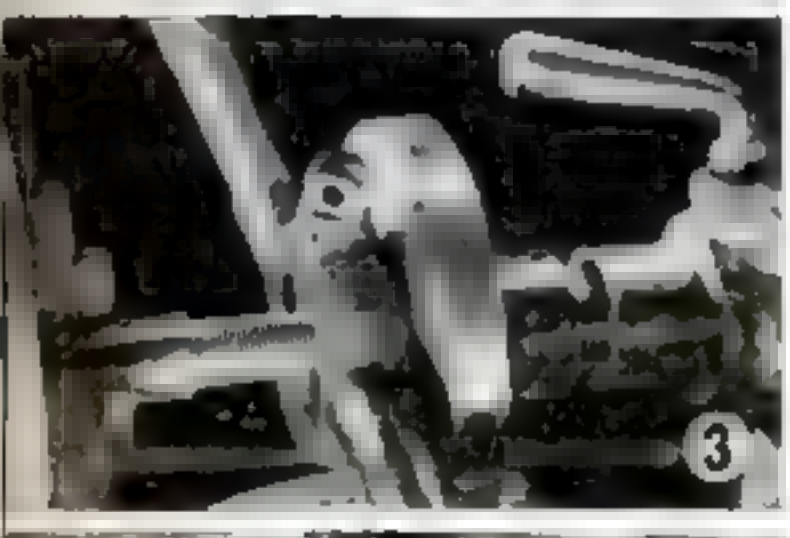
Center punches also should be made in several sizes, from small-diameter rod for fine work and large-diameter rod, as illustrated, for heavy work. They can be tapered in a lathe. Set the compound rest at the proper angle to the work (Fig. 6). The points can be ground after hardening. A 90-deg. angle is best for center punches and 40 deg. for prick punches for delicate work.





MACHINISTS FOR DEFENSE

Boring Bar Holds Tool Bit Securely for Heavy Cutting in Small Lathe



THE boring bar shown in Fig. 1 makes use of a hollow sleeve for locking the tool bit rigidly in place. With the bar designed in this manner, the greater the strain put on the cutting edge, the tighter the tool bit will be held. Heavy roughing cuts or the constant pounding of interrupted cuts will not loosen it, although it can be instantly released by a backward turn.

The dimensions given in the accompanying drawings are for $\frac{3}{4}$" diameter boring bars, but it will be found wise to make another set $\frac{1}{2}$" in diameter as well. Both sizes will be ideal for use in the small lathe. There should be two sleeves and two tips for each, one set with a 45-deg. square hole for facing and boring, and the other with a square hole at a 90-deg. angle for boring and internal threading.

Drill rod is best for the smaller size, but mild steel is stiff enough for the larger. With the stock chucked, a hole is drilled in the end of the rod and, with the tap supported by the tailstock center, the internal threads are accurately cut (Fig. 2) to receive the boring-bar tip. This tip is made by chucking a short piece of $\frac{5}{8}$" rod, turning to size, and threading (Fig. 3). An ordinary stock and die can be held precisely at right angles to the work by bringing the drill pad against it and turning the tailstock handwheel forward until the threads are started accurately.

The hollow sleeve can be a piece of Shelby tubing, or it can be made from solid steel. Figure 4 shows the finished sleeve slipped over the boring-bar tip and held in a drill-press vise as both are drilled at a 45-deg. angle. The hole is then filed square, as in Fig. 5, to receive the tool bit, and the boring bar is ready for use.

A Jig for Bending S-Hooks into Links for Special Chains

S-HOOKS can be made in the vise and assembled into chains for suspending porch and lawn swings and for other purposes for which manufactured chains are not immediately available.

The jig illustrated was made for bending S-hooks from stock ⅛" to ⅜" in diameter and either 8½" or 10½" long. Electrodes used by electric welders form hooks of sufficient strength for a porch swing and similar purposes.

Take a piece of ½" by 2½" by 8" flat stock as shown in Fig. 1, and drill and tap it from the underside to take three ⅜" by 4" nipples, *A*, *B*, and *C*. Then make two handles as shown in Fig. 2. The pin *D* is simply a ⅜" bolt 1 9/16" long under the head, with the head machined round and to a thickness of ¼". A ⅜" nipple *E*, 1" long, is slipped over bolt *D* before screwing it into the handle; it serves as a roller when bending the stock. Pin *F* is a piece of ⅜" by 5 5/16" round stock, threaded on one end for a distance of 1 13/16", and is screwed into the handle from the underside so that it extends above it 1 5/16". A ⅜" by 1" pipe nipple *G* is slipped over the threaded portion of *F*; a ⅜" nut *H* holds it in position. This nut is machined round and to a thickness of ¼".

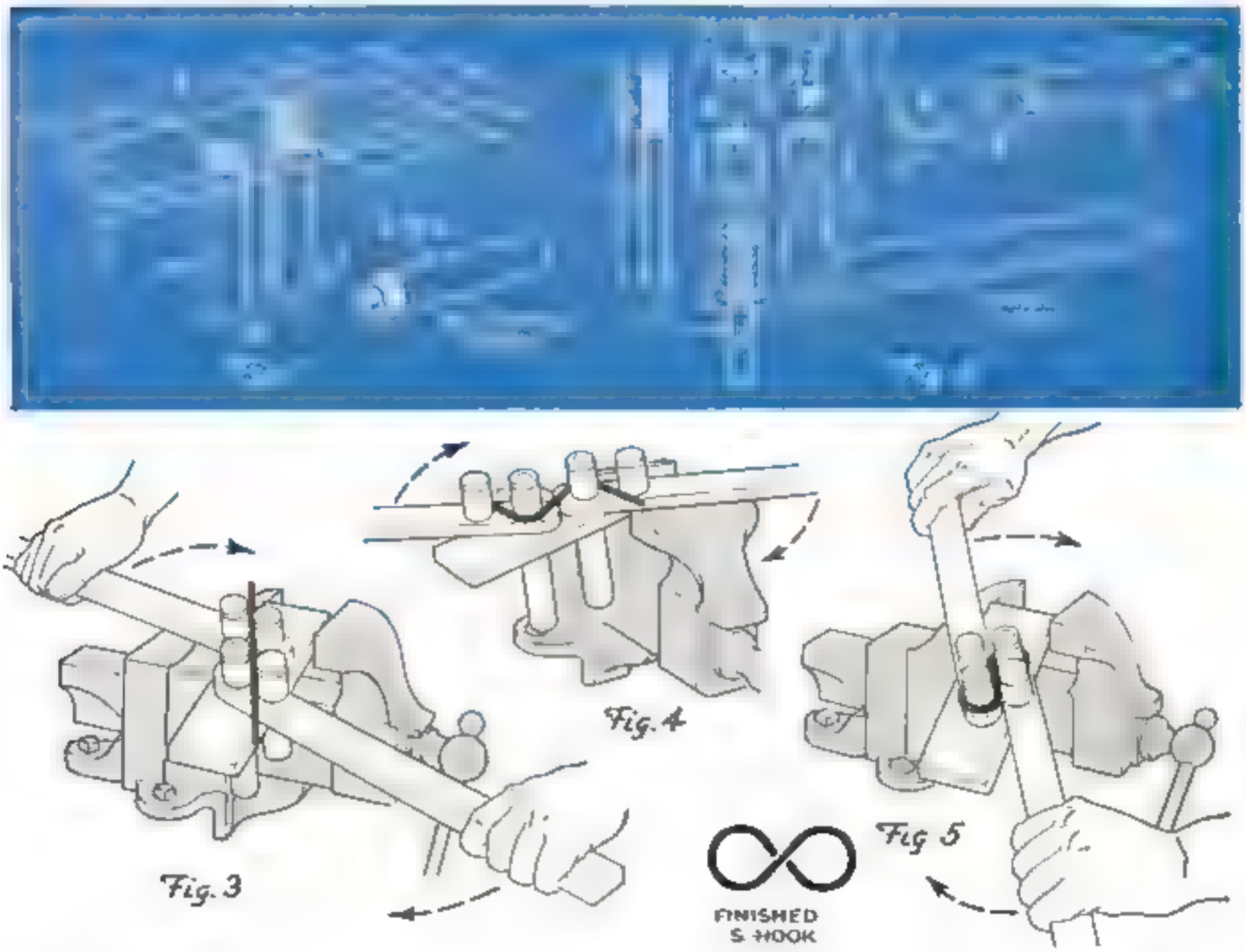
When assembled for bending stock 8½" long, pin *F* of one handle fits into nipple *A* shown in Fig. 1, while pin *F* on the other handle fits into nipple *C*. In bending stock 10½" long, pin *F* of one handle is removed from nipple *C* and placed in nipple *B*. Should S-hooks be desired with larger eyes, shims can be placed around rollers *E* and *G*.

Figures 3, 4, and 5 show the first, middle, and final positions of the handles when bending straight stock into S-hooks. It is important that the stock be centered exactly between the rollers, as shown in Fig. 3, otherwise, the size of the eyes will not be uniform.—WILLIAM J. HARGEST.

Scotch Tape Marks Depth on Drill

TO INDICATE the depth of a hole to be drilled, a piece of black or colored Scotch tape may be wound around the drill or bit at the desired point. The tape is quickly removed after use and leaves no undesirable stickiness.—MARION E. WESP.

Nipples set in a drilled and tapped piece of flat stock form a firm base into which two handles, fitted with pins and nipples, can be turned clockwise for bending a short length of rod into a uniform S-hook



Rack on Top of Automobile Holds Six Pairs of Skis and Poles

SIX pairs of skis and poles can be carried on this simply constructed automobile ski rack.

Shape the bottom of the legs to fit the slant of the car roof. The clearance between the crosspieces of the rack and the center of the car top should be not less than 2". Use waterproof glue to hold the sponge-rubber pads to the legs.

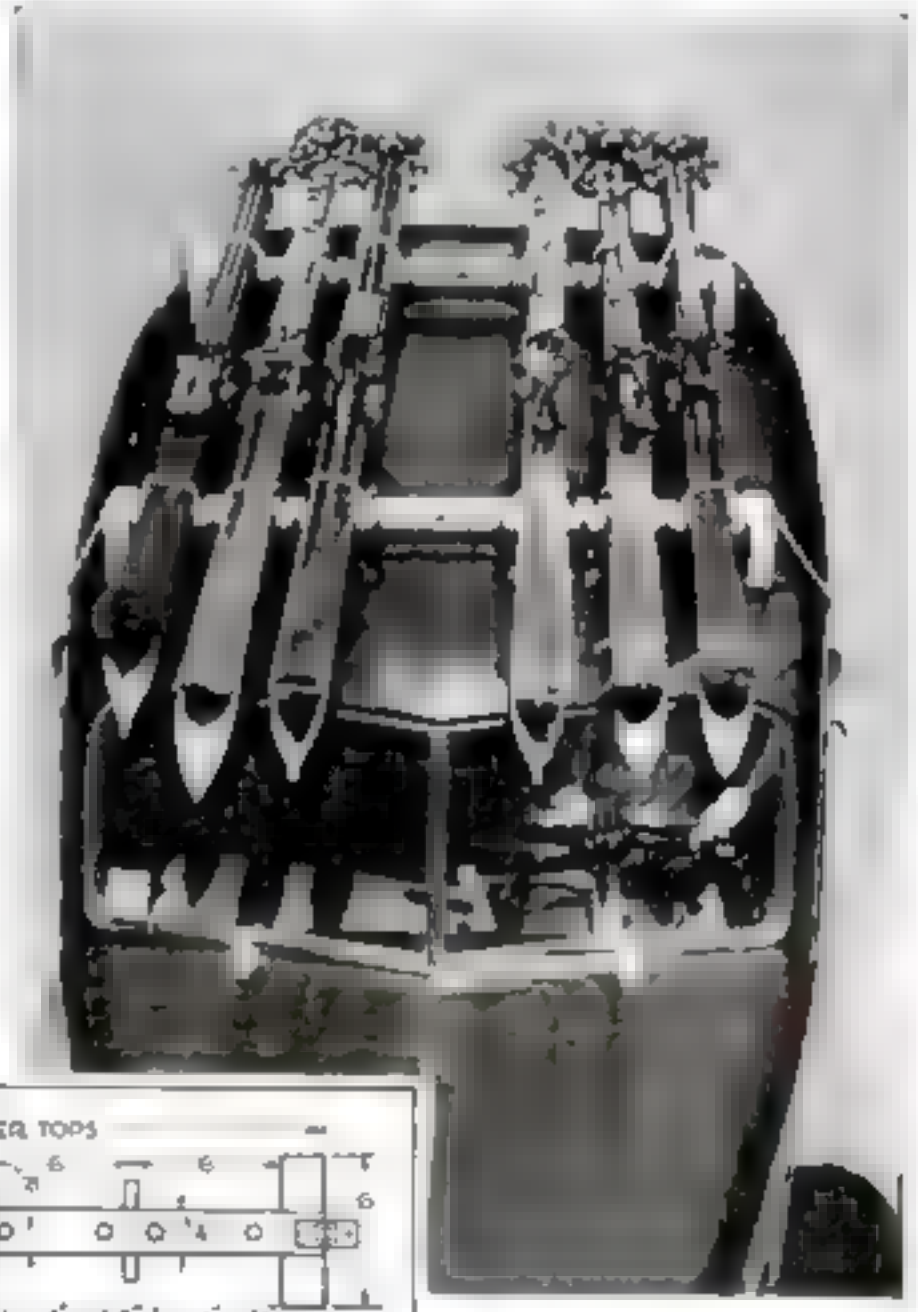
In making the strap-iron fittings, bend one end into a hook to fit the gutter on the side of the top, and cover the hook with rubber or friction tape to prevent scratching. Center a crosspiece and measure from the end hole on the hinge to the gutter of the top. This distance minus a 4½" allowance for the turnbuckle is the length to cut the iron pieces, of which four are prepared. A ¼" hole is drilled in the end of each. The length of the front straps will be shorter than that of the back. Open up the eyelets on the ends of each turnbuckle about ¼" for hooking into the hinge and strap iron. Apply two coats of a high-grade outside paint to preserve and protect the rack against the weather.

To fasten the rack, center the crosspieces on the top of the car about 36" apart. Hook the turnbuckle and straps on the left side, and fasten to the gutter. Do likewise on the other side. Tighten equally the four turnbuckles to prevent slipping. Tie each pair of skis with the bottoms together and place between the dowels with their tips toward the front. Place a pair of poles parallel on top of the skis, with handles under the toe strap and tips hanging over the back of the skis. Loop the end of a length of rope around the first dowel on each side and lash the skis to the rack. When carrying many ridge-top skis, drive two rubber-headed tacks or nails about 1¾" apart between the dowels on the top.

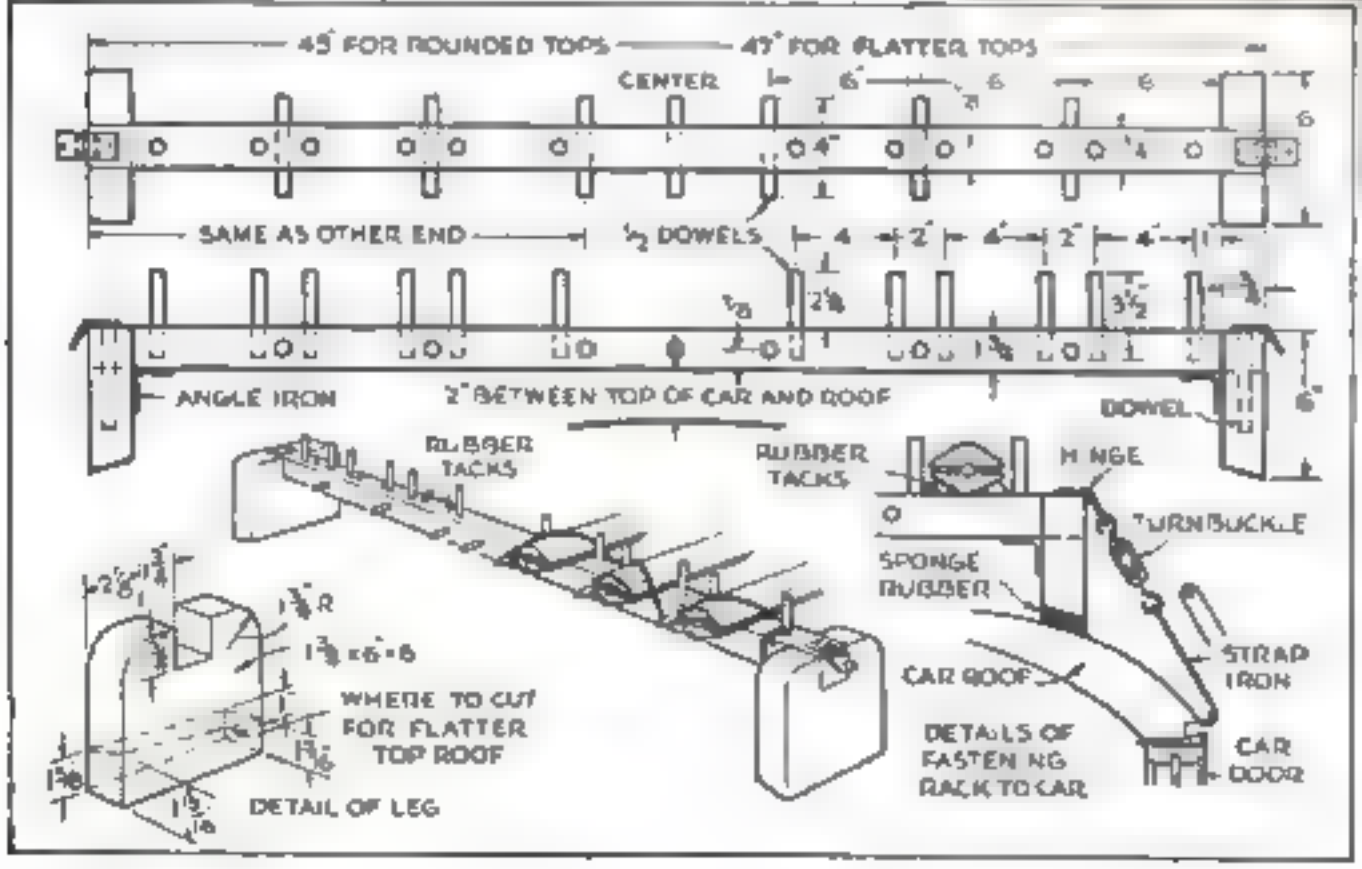
This ski rack can also be used to carry a canoe or light boat.—CARL T. WITHERELL.

MATERIALS

1 pc. white pine, 1¾" by 10" by 47"
4 back-flap hinges, 1¼"
10' maple or birch dowels, ½"
4 angle-iron braces, 1½"
4 turnbuckles, 8"
3' strap iron, ¾" by ⅛"
4 lengths rope, 7' long
Sponge-rubber kneeling pad, screws, waterproof glue, paint, etc.



Skis and poles tied in pairs are lashed to the rack by lengths of rope looped over an upright dowel and pulled tight on the horizontal ones



Working drawings to the left show construction details of crosspieces, alternate types of legs, and strap-iron fittings. Note spacing of dowels and how legs are padded

Opening 2" by 3" and hinged metal door provide draft

Roll 1" by 3¼" strips of tin can on a dowel for tubes

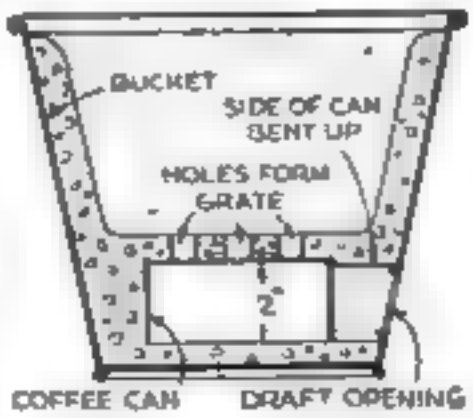
Fire-clay mixture is built up to top of tubes

Charcoal-Burning Fire Bucket Takes Chill Off Winter Sports

SKATERS and other winter-sports fans will appreciate this handy fire bucket. Reviving numbed fingers is only one of its uses. Over it you can heat chocolate and other beverages at the lake shore, or, if adequate ventilation is provided, it will warm a fish house or ice-fishing shanty. Nor does its usefulness end with winter, for it makes an efficient picnic stove, and with a grate will grill steaks, toast marshmallows, or cook coffee.

Cut an opening in a 10- or 12-qt. galvanized bucket about ⅓" above the bottom for a hinged sheet-metal door. Mix 10 lb. of fire clay in the ratio of one part clay and five parts silica sand or crushed fire brick with just enough water to form a stiff paste, and spread the mixture ½" deep over the bottom of the bucket.

Make two parallel cuts up the side of a squat coffee can so that a 2" by 3" piece can be bent up parallel with the bottom. Then punch five or six ¾" holes in the bottom of the can. Into these fit tubes made of tin-can metal. Center the can on the bottom of the bucket, and use tin plate to form the sides of a tunnel connecting the two openings. Add more of the clay mixture over the top of the coffee can; then build up a 1" layer on the inside of the bucket up to the top, smoothing as well as possible.



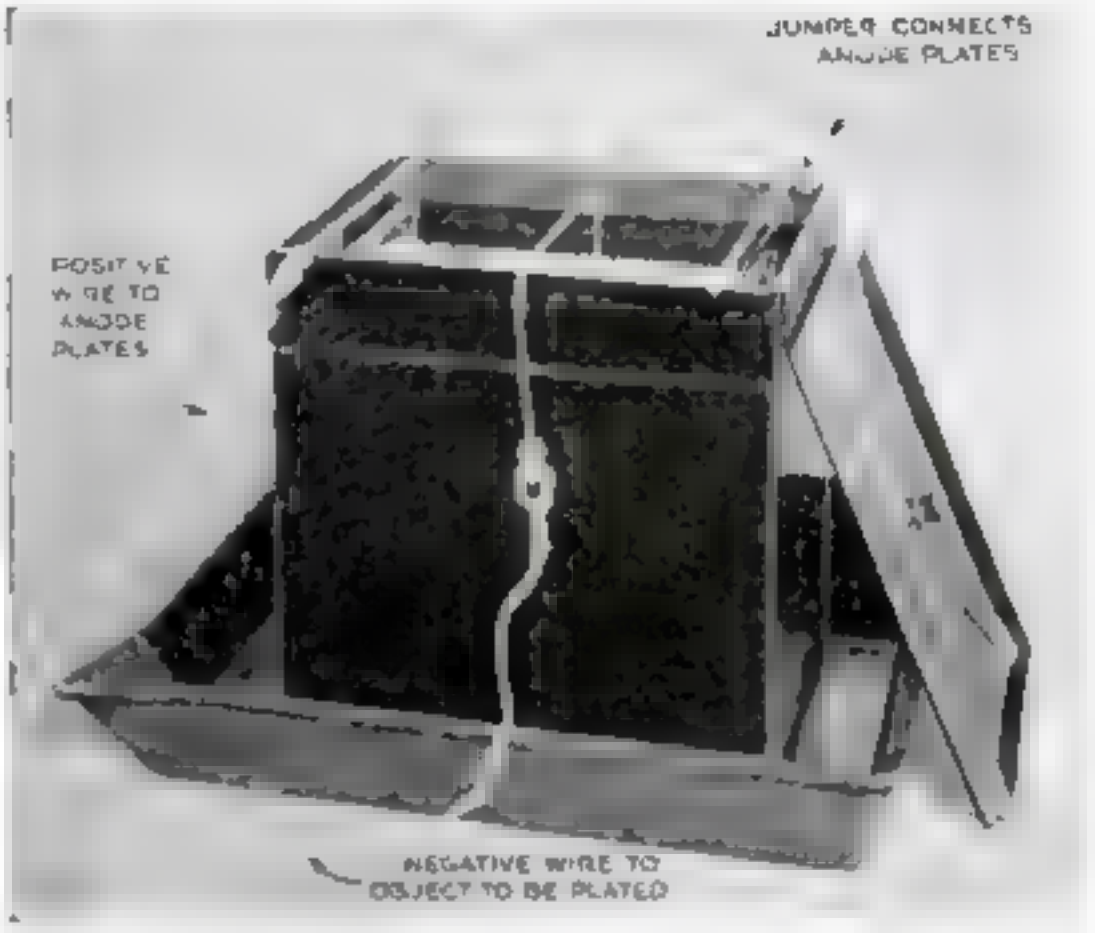
The first fire, after the clay is thoroughly dry, should be a small one to "burn in" the lining. Some cracks may appear later, but usually do no harm. Always set the bucket on stone or some other fireproof support, and use it outdoors or in a well-ventilated place.

To start a charcoal fire, use paper, excelsior, or wood splinters, and close the draft partly or wholly after there is a good bed of coals.

Large Hard-Rubber Photo Tank Useful for Electroplating

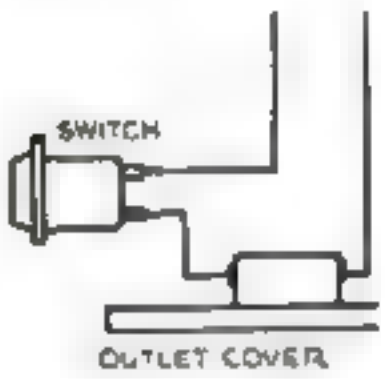
FOR chemical resistance and all-around durability, a hard-rubber tank is ideal for electroplating. One of the 3½-gal. size, which can be obtained at moderate cost at a photo supply house catering to professionals, is about right for the average home workshop. A floating lid adds a trifle to the cost, but helps in cutting down the evaporation of solutions left in the tank for a short period of time. A hard-rubber tray under the tank will catch spilled solution.

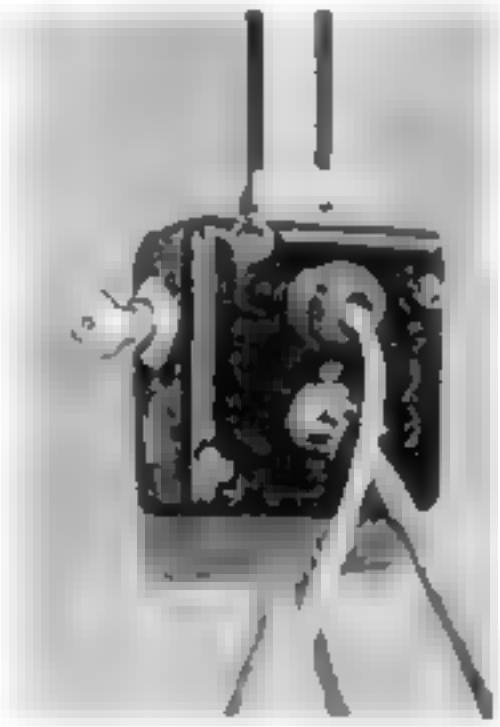
Anodes are hung by heavy wires at opposite ends of the tank, and the object to be plated hangs in the center. The distance between anodes and object is easily adjusted by sliding the wires along the rim of the tank. If fixed spaces are required, notches may be filed at measured intervals into which to drop the wires.—K. R. SIPPLE.



For electroplating purposes, a hard-rubber tank intended for photographic developing and fixing, such as the one above, is a good investment. It is durable and resists chemical action

Current can't flow through this outlet box when the key is removed. Below is a diagram of wiring for the connection with an auto switch



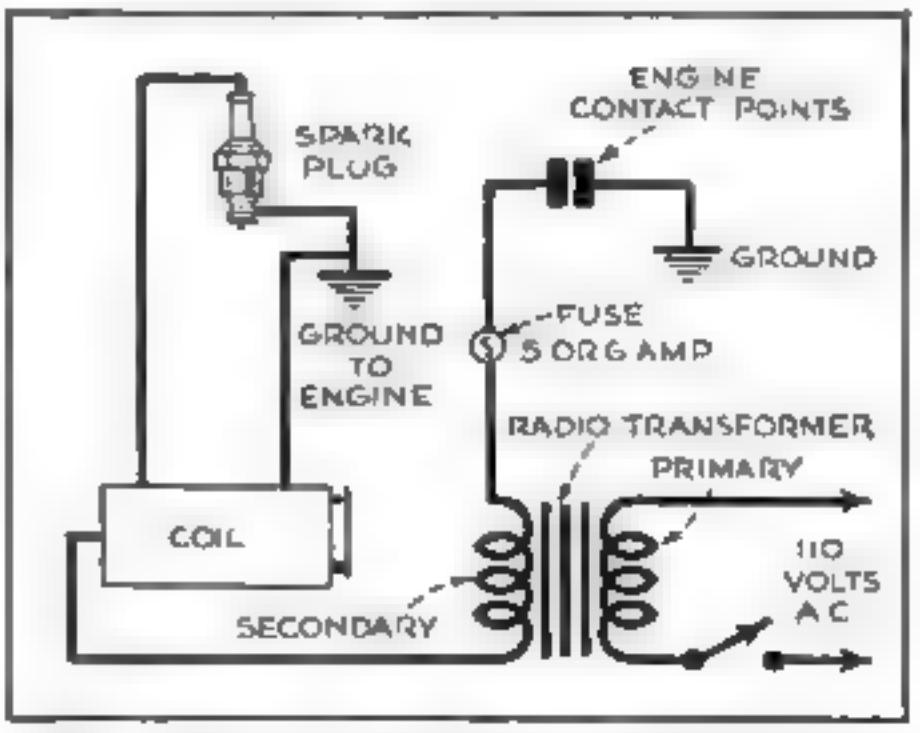


Ignition Switch in Outlet Box Puts Power Tools Under Lock

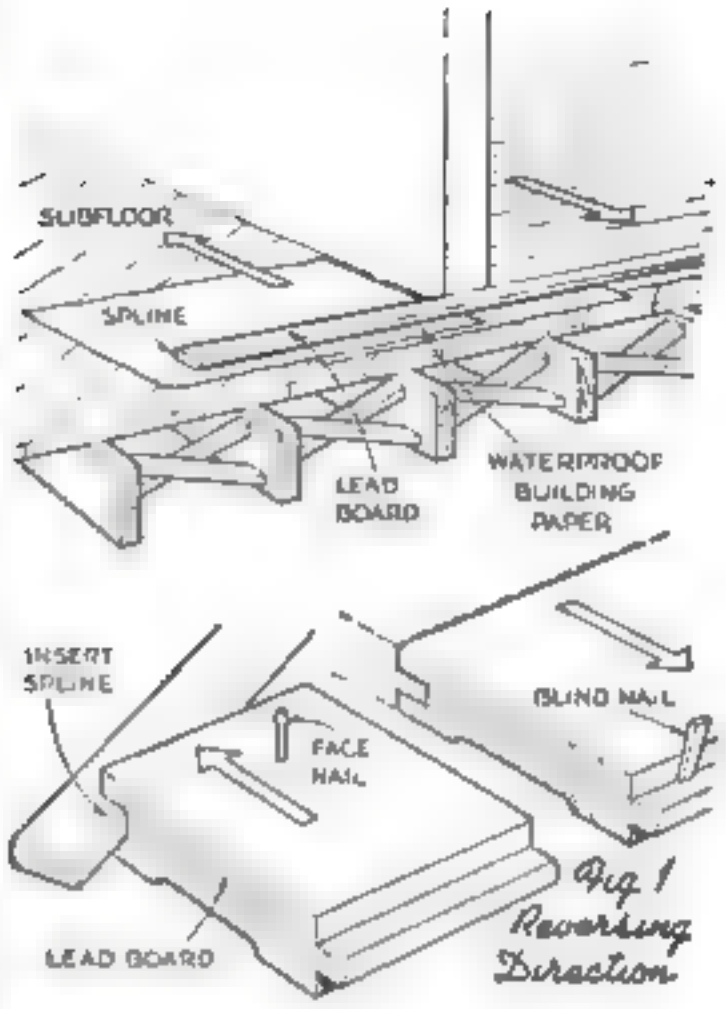
POWER tools can be locked so that children cannot start them by removing one of the knockout disks on the side of the electric outlet box and inserting in the circuit an ordinary automobile ignition switch worked with a key. A suitable switch can be purchased at any large auto supply store. One of the plug outlet wires is connected with the switch, and another short wire is run from switch to outlet. The key must then be turned before the circuit can be put into service.—W. E. JACOBSON.

Gas Engine Ignition System Run by Radio Transformer

IF A STATIONARY gasoline engine is located where 110-volt power is available, the expense of battery ignition can be saved by running the ignition system with a radio power transformer. Connect the primary of the transformer to the line through a switch. If the transformer has a 6.3-volt filament winding, connect this to the ignition system. If it has a 5-volt and a 2.5-volt winding, connect these together to get 7.5 volts. A 5- or 6-ampere fuse will protect the secondary winding from burning out in case of an accidental overload or other serious difficulty.—T. KEMPLING.



Wiring details for hooking up the ignition of a stationary gasoline engine with 110-volt current



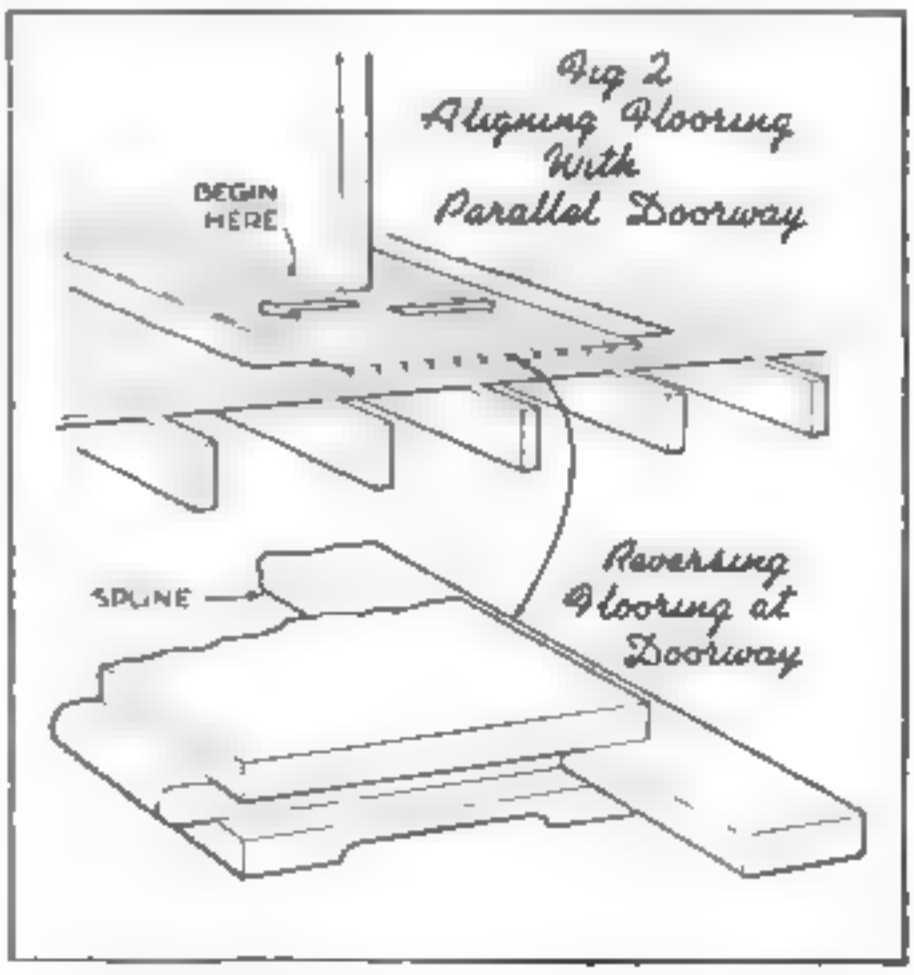
Inserting a spline to convert the groove in a board into a tongue for a floor that is carried from one room to another. Never blind-nail through a spline; it is likely to split. The boards joined by the spline should be face-nailed instead

Laying a Floor Continuously from Room to Room

IF HE uses a few tricks of the trade, any amateur builder can do a good job of laying a continuous run of flooring from one room to another. For example, after laying through a doorway, the working direction of the flooring is reversed so that the rear portion of the second room can be laid by working backward. This is done by converting the grooved edge of the leading board into a tongued edge. Simply insert a thin wooden spline into the groove as shown in Fig. 1.

For splines, use strips cut from straight-grained stock of the proper thickness to make a snug joint. Do not, however, attempt to blind-nail through a spline, as it is likely to split. Instead, face-nail the two boards joined by it; then countersink the nailheads, and fill the holes later.

Figure 2 illustrates a method of laying a floor in true parallel alignment with a prominently located doorway between rooms. To accomplish this, begin to lay the flooring at the doorway partition, rather than at an opposite wall. Start by face-nailing the first piece with its grooved edge pressed firmly against one side of the partition. Then proceed to lay in both directions, inserting a spline to reverse the flooring at the doorway. If, when the far walls are reached, the flooring does not run true with them, insert wedge-shaped pieces to fill the openings. A slight misalignment along a wall usually is not noticeable enough to cause trouble.—JOHN MOIROCH.



Concrete Protects Fuel Oil Lines Laid on Basement Floor

COPPER tubing conveying fuel oil from outdoor storage tanks to furnaces and water heaters can be protected against accidental damage where they pass through house basements by embedding them in concrete floor moldings skirting the walls. Lay the tubing on the floor along the wall and trowel concrete into the corner, as shown. A 1-to-3 mixture of cement and washed sand should be used. Wet the old concrete of floor and wall thoroughly before applying the new to insure a better bond.

Priming Blowtorch Without Soot

WHEN a blowtorch is started indoors, alcohol may be used to advantage in the priming pan instead of gasoline. This preheats the burner effectively, yet burns with a clean, blue, sootless flame.—ROBERT P. STOREY.

Edge of Scratch Pad Cemented to Bind Its Leaves Firmly

SCRATCH pads sometimes have the troublesome habit of shedding their top leaves at the wrong time. This can be remedied by cementing a strip of paper along an unbound edge so the leaves are held along two right-angled edges. Apply rubber cement to both the pad edge and the strip of paper. When dry, trim the strip flush. This method may also be used to make pads from scrap sheets. As the pad becomes thinner, trim the projecting paper strip.—W. E. B.

ODORLESS SOLUTION [*METAL ETCHING—9*]

This solution may be successfully used for etching copper and brass: Dissolve 3 oz. of potassium bichromate in 3 oz. of water, then add 3 oz. of concentrated sulphuric acid and about 1 teaspoonful of liquid soap. Although extremely slow, the solution enables etching to be done where it would be impossible to use the nitric-acid process, which always gives off disagreeable fumes.

Clean the metal thoroughly with a dry abrasive such as whiting or plaster of Paris. Do not scratch the surface of the metal as the acid will attack deep scratches much more vigorously than a smooth surface. Paint all parts to be left unetched with asphaltum varnish, or paint the entire surface, front and back, let dry, then scratch the letters or design through the asphaltum.

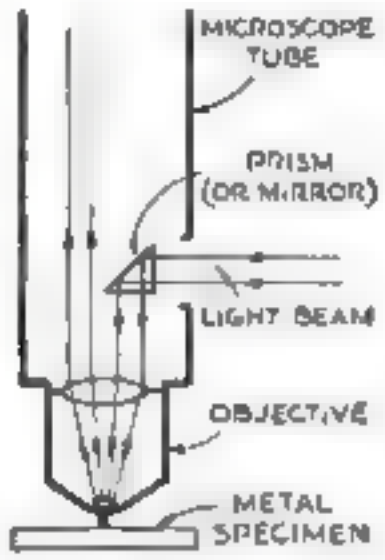
Lower the piece carefully into the solution for etching. With the temperature of the copper about 60 deg. F., the solution will etch to a depth of approximately 0.0025" per hour. It is slightly slower with brass. A higher temperature will increase the speed, but the temperature should not go above 80 deg. F.

For etching aluminum add a little hydrochloric acid. Test the strength of the bath on a scrap of aluminum, and if not strong enough add more acid.

Store the etching solution in glass-stoppered bottles. Asphaltum varnish is best removed from the finished work with kerosene or lacquer thinner.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Metal study under a microscope requires vertical lighting by an attachment such as the illuminator on the left, details of which are given below. The special short-mount type of objective shown on the table is used in laboratory tests



Secrets of Metal Structure

REVEALED BY YOUR MICROSCOPE

By MORTON C. WALLING

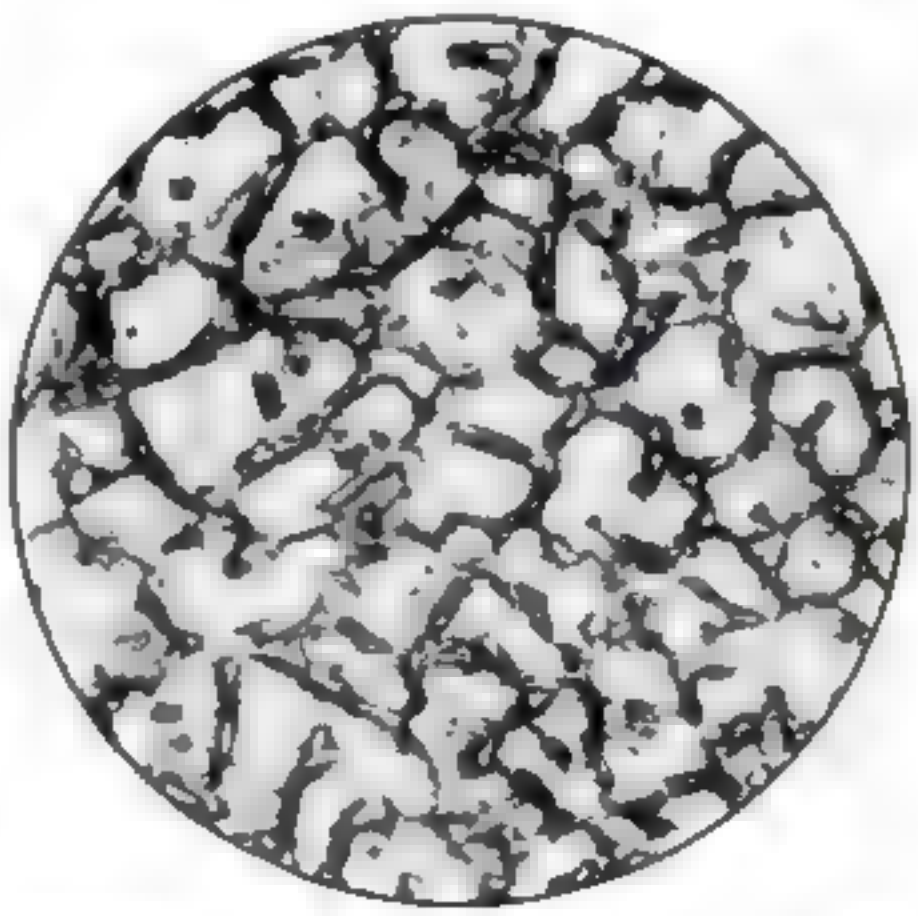
MICROSCOPES are used more extensively for examining the granular structure of metals than, probably, for any other industrial purpose. The motor car and airplane, for instance, would not be nearly so efficient if it were not for thousands of microscopes in the hands of skilled technicians.

Metals in common use, and especially alloys, rarely present a homogeneous structure, but consist of various particles more or less firmly united. Strength, brittleness, hardness, and resistance to corrosion depend on their composition and crystalline structure; and that is why the metallurgist can tell as much about steel by examining its microstructure as a physician can about a patient by a microscopic analysis of his blood.

Without extensive knowledge of the chemical and physical composition of metals, you can venture into metallography through the medium of your microscope. You may have to alter some previous conceptions, however, for metal cannot be reduced to thin sections through which light will pass. Examination must be by reflected light only.

There are two methods of illumination the amateur can use. First, he can direct a light beam from the side, so that it passes beneath the nose of the objective lens and illuminates the area being examined. This works only with objectives of rather long focus, which do not have to be adjusted close to the specimen.

The other method is to direct the beam



Granular structure of annealed brass as revealed through the microscope. Etching on the polished surface of the specimen here has been rather deep

Steps in preparing a brass disk for examination of grain structure. First, the surface is filed flat. An abrasive stick like that in the foreground will remove coarse file marks. Next, the disk is honed on an oil-lubricated stone; then it is rubbed on crocus (Turkish emery) paper of very fine grit . . .

down through the objective lens so that it strikes the metal surface and is reflected back to the eyepiece. For this, a special attachment called a vertical illuminator is used.

You can purchase an illuminator reasonably, or you can make one. There are two kinds, one employing a mirror or reflecting prism, the other a thin glass that acts as a mirror and also lets light pass through it.

The one using a mirror or prism is useful up to about 100 diameters magnification. Over that, the transparent-mirror type is preferable. It also is easier to construct. For the reflecting element, use a No. 1 or No. 2 cover glass. For the body, use brass, easily worked plastic, or cardboard. If you have no "Society" taps and dies (for standard objectives), strips of paper will produce a tight fit between unthreaded ends of the attachment and the threaded objective and microscope tube. There must be clearance between the objective and the specimen. If necessary, mount the specimen beneath the stage, and focus through the hole.

The next step is to polish the metal to be examined, which must be done with scientific precision. Here is a routine which will enable you to see crystalline structure with a fair degree of success:

1. Prepare a block or disk of the metal ½ to ¾ inch in diameter and thick enough to handle, say ¼ to 1 inch.

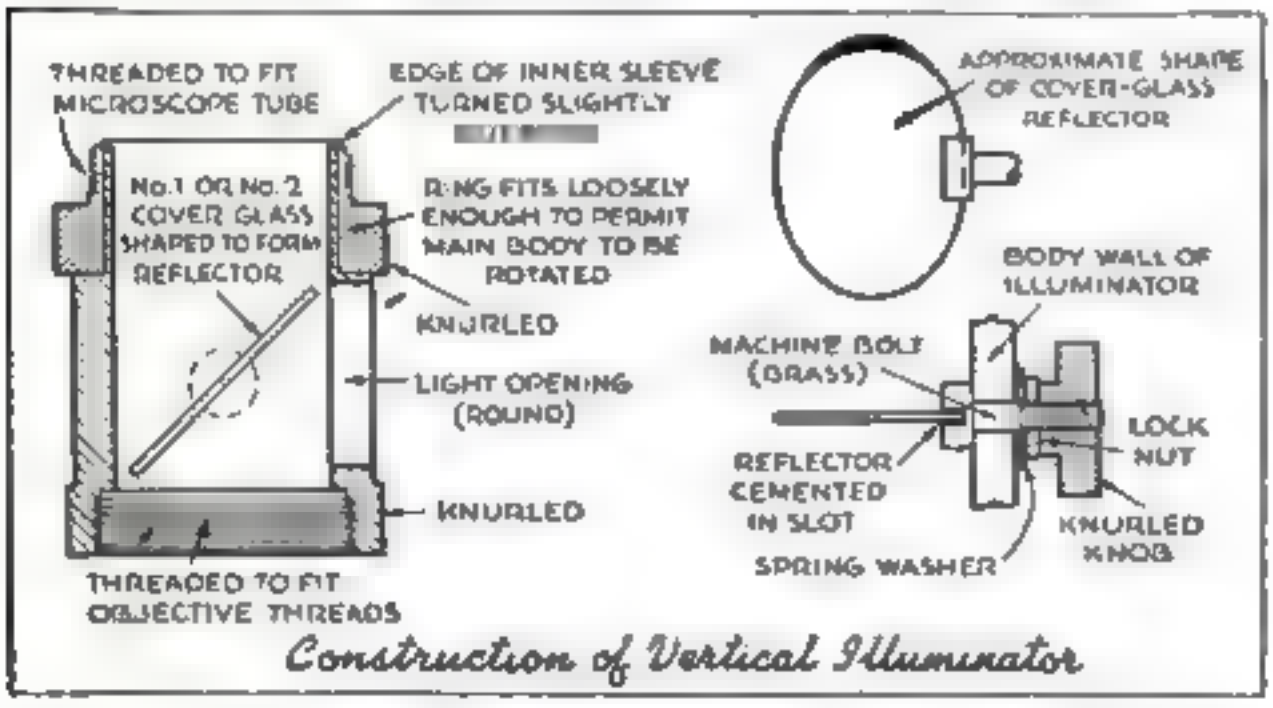
2. Grind or file the face flat, and level with the base.

3. With an oilstone or No. 1 emery cloth or paper, remove the scratches. This requires considerable rubbing. Lay abrasive paper or cloth on a flat surface, and rub the specimen back and forth, rotating to cut in various directions; or rub one way for one abrasive, and at right angles for the next finer grade.

4. Continue polishing on succeeding grades. From a jeweler or jeweler's supply house, obtain crocus paper or cloth. Three sheets of grades 00, 000 and 0000, will bring a specimen up to a condition for final polishing. You can use a little light oil for lubrication.

5. Spread levigated alumina or rouge on broadcloth, or use it to charge a power-driven, cotton buffing wheel, and work the polish to a high degree. Either red rouge or the "white" of jewelers, in sticks or powder, may be used.

6. Finally, charge a piece of soft velvet or similar cloth with rouge or fine alumina, and rub the specimen over it with light pressure until the tiniest scratches disappear. The specimen is now ready for etching. The sequence is not as complicated as it seems. A specimen of brass, for example, may be pre-



Construction of Vertical Illuminator

Diagram of the parts of a transparent-mirror vertical illuminator. The light passes through the glass in addition to being reflected by it

. . . Buffing is done on a soft cloth wheel charged with alumina, rouge, or other fine abrasive; then the specimen receives its final polishing on soft (chiffon) velvet charged with very fine alumina or rouge. The last step, etching in hydrogen peroxide and ammonia water, to get the microscope view below

pared for examination in a few minutes.

When changing from one abrasive to a finer grade, wipe the specimen with cloth to remove every trace of the coarser material, and wash your hands. At the end wash the polished specimen with xylol or another grease solvent to remove traces of oil, and then wash it with ordinary soap and water. Dry the polished surface of steel or iron by dipping in alcohol or dioxan.

To make the structure visible, the polished surface must next be etched to remove the "skin" caused by compacting or flowing during polishing. The etching chemicals also bring the crystalline structure into better view by acting selectively on the different particles. The following solutions are suitable:

For steel:

Methyl (wood) alcohol, absolute	20 cc
Nitric acid, concentrated	1 cc

Or you can use. . . .

Ethyl (grain) alcohol	10 cc
Nitric acid, concentrated	1 cc

Etch until the grain structure is clearly distinguishable with the microscope. Sometimes a few seconds is sufficient. Rinse in either ethyl or methyl alcohol, and dry.

For brass:

Hydrogen peroxide	1 cc.
Ammonium hydroxide (aqua ammonia, etc.)	6 cc.

Etch five seconds, wash with water, dry and examine. Repeat if necessary.

For alloys of lead, tin, bismuth, antimony:

Water	100 cc.
Silver nitrate	4 grams

A black deposit will form on the metal. Remove this with wet cotton.

For aluminum:

Water	100 cc.
Ferric sulphate	6 grams

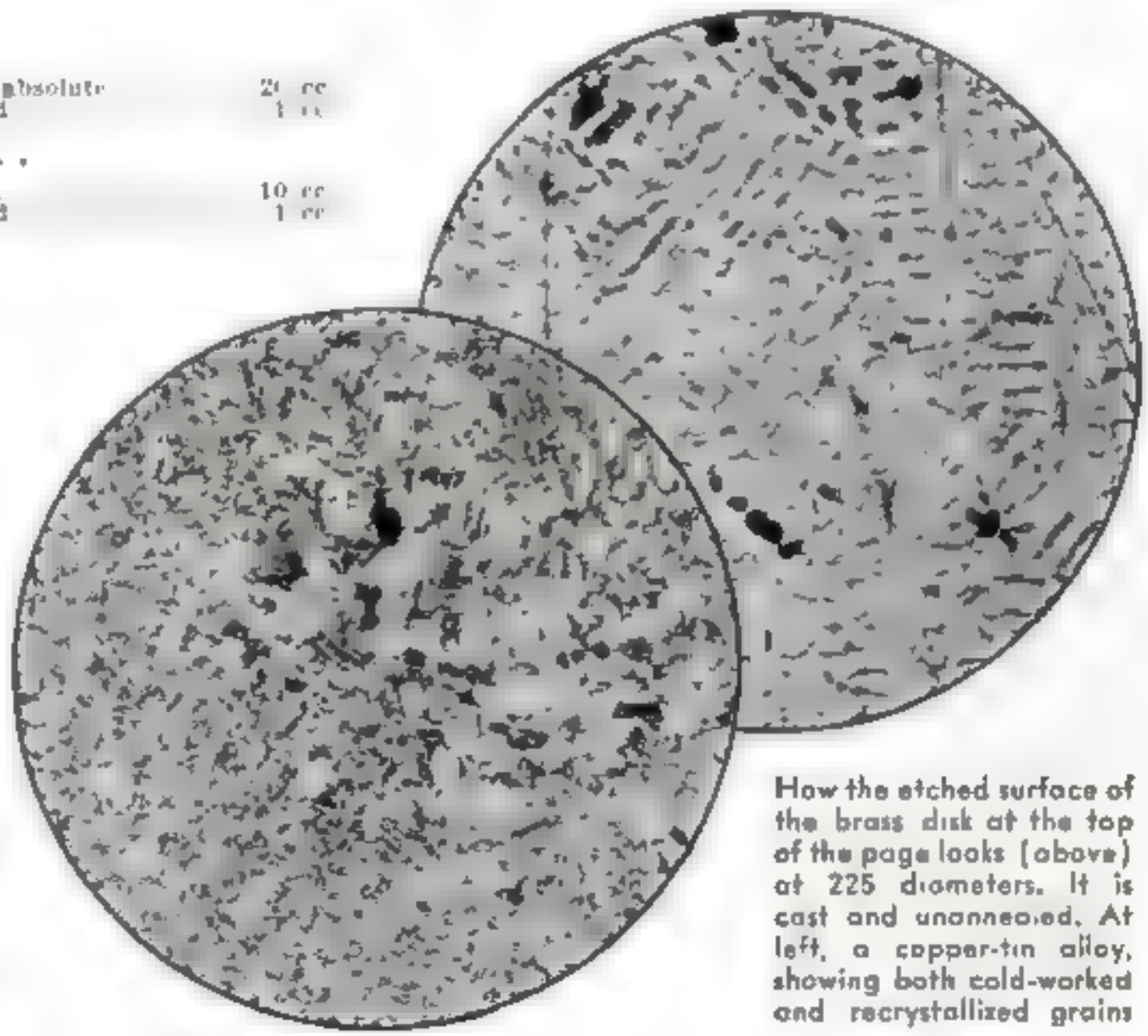
Etch about two and a half minutes.

Or you can use. . . .

Water	100 cc
Sodium hydroxide	1 to 10 grams
Ethyl alcohol	1 to 5 cc.

Wash; remove any black coloration by immersion for a second or two in nitric acid.

A prepared specimen should be handled with great care. It can be cemented to the bottom of a cardboard pill box.



How the etched surface of the brass disk at the top of the page looks (above) at 225 diameters. It is cast and unannealed. At left, a copper-tin alloy, showing both cold-worked and recrystallized grains

Portable Radio-Phonograph

World's Smallest Model Has Four Tubes and Is Compact for Carrying

By ARTHUR C. MILLER

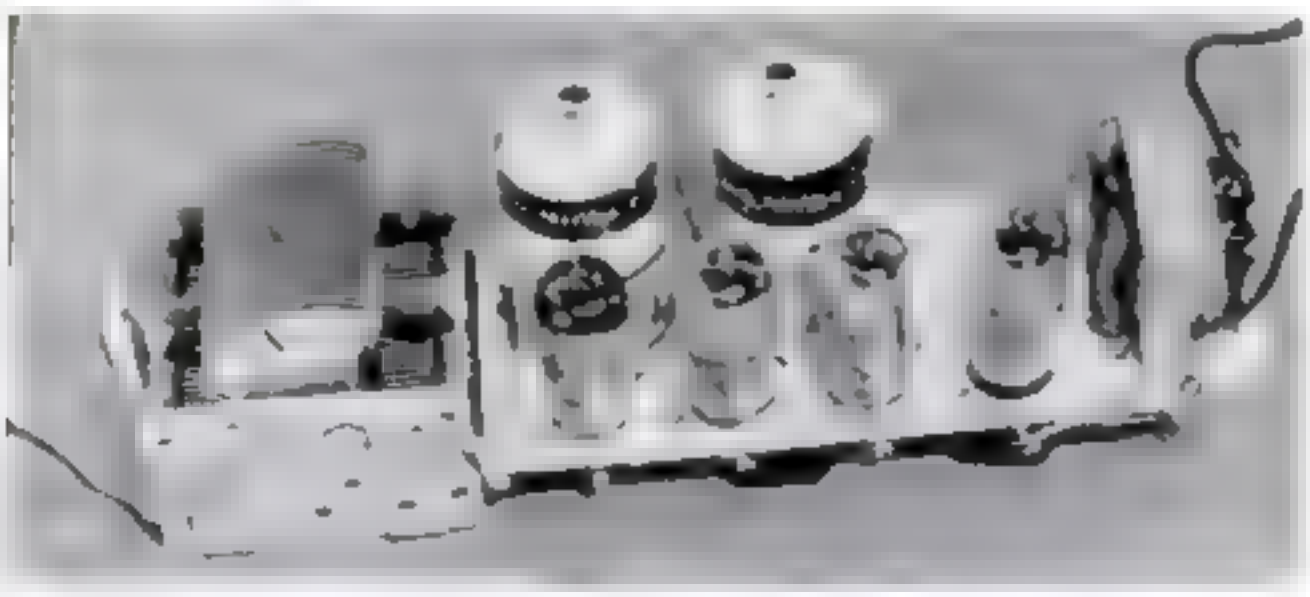
Assembled portable radio phonograph, showing 6" turntable, volume control knobs, and dial

JUST a year ago, there came from radio factories the first midget portable radio, weighing 4 lbs., light enough to carry about like a camera. There have not yet been any really compact portable radio phonographs. The plans given here for building the world's smallest portable radio phonograph are the first to be published.

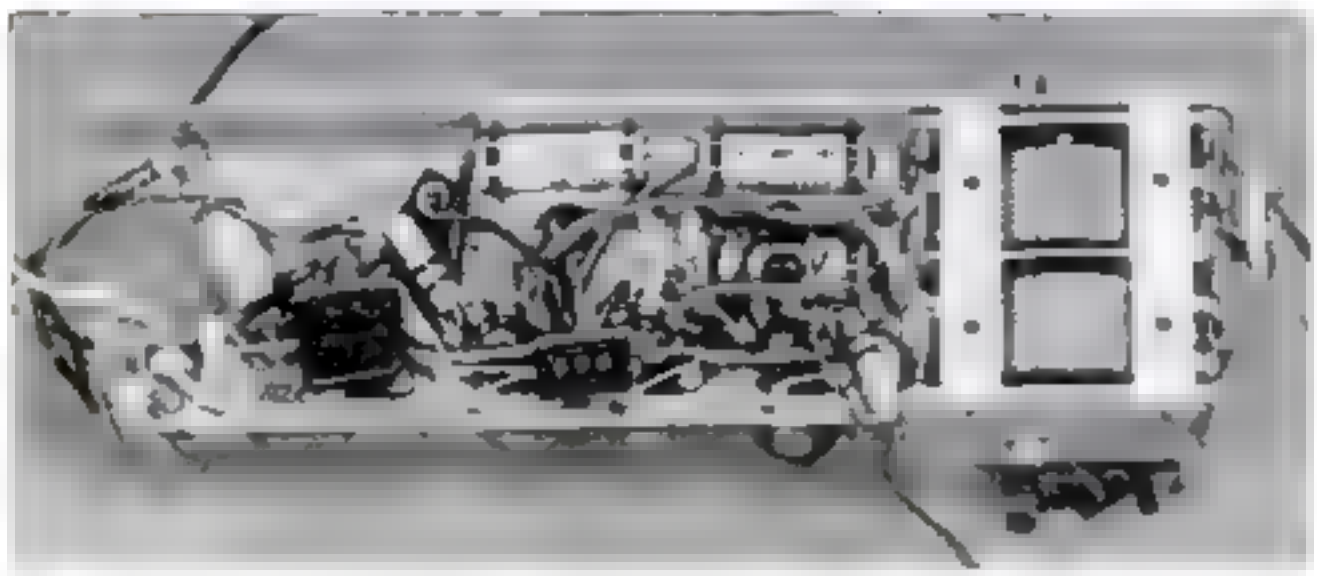
Built into a case 9¾" by 8¾" by 4½" is a complete phono-amplifier, crystal pick-up, spring-wound phonograph motor, 6" steel turntable, four-tube radio receiver, 4" permanent-magnet speaker, 67½-volt "B" battery, 1½-volt "A" battery, and 3-volt "C" battery.

The four-tube radio circuit uses three 1T4 miniature seven-prong tubes (two as RF amplifiers and the third as a detector) and one 3Q4 miniature seven-prong tube (a beam power pentode, used in the output stage and handling up to 270 milliwatts; it is also the phono-amplifier tube).

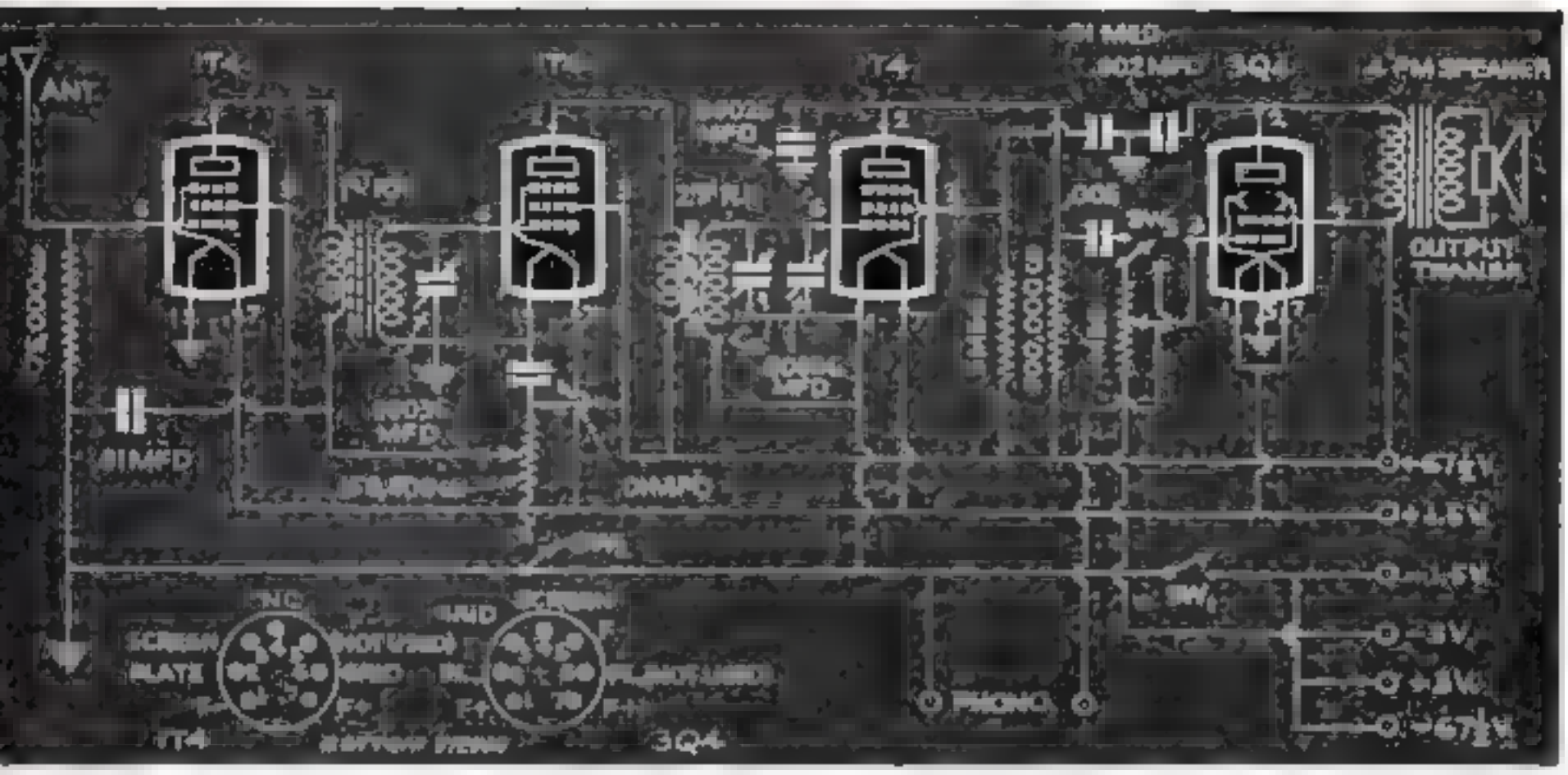
Two stages of RF amplification are employed with only two .00036 mfd. tuning condensers because in the untuned antenna circuit the tuning condenser has been replaced by a 75,000-ohm, ½-watt resistor connected be-



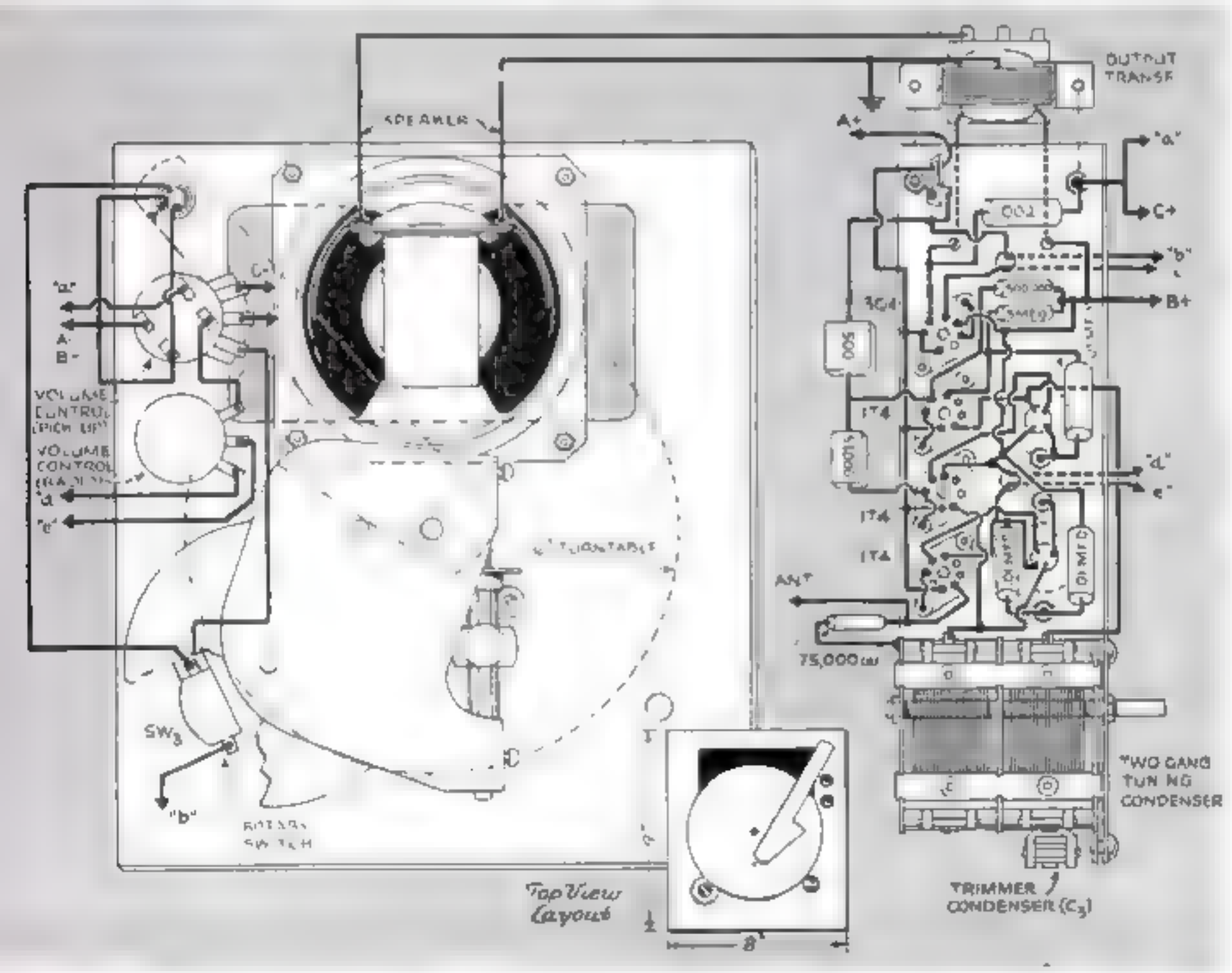
Top view of radio chassis. Left to right, trimmer and tuning condensers, three 1T4 tubes, one 3Q4 tube, and output transformer



View of radio chassis from the bottom, showing neat arrangement of the paper tubular condensers, tube sockets, and resistors, which permits installation along with equipment for a phonograph in a compact, convenient carrying case

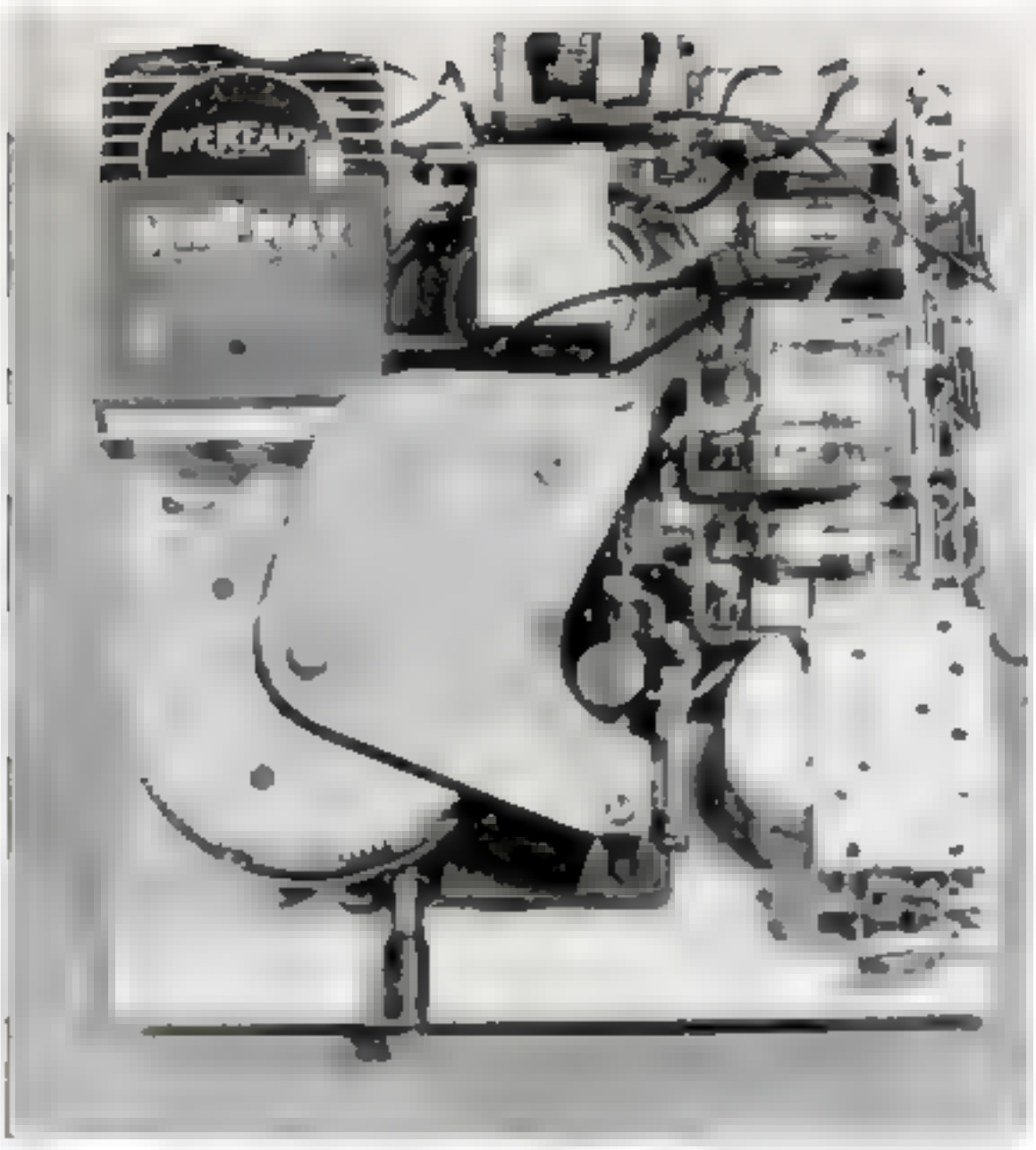


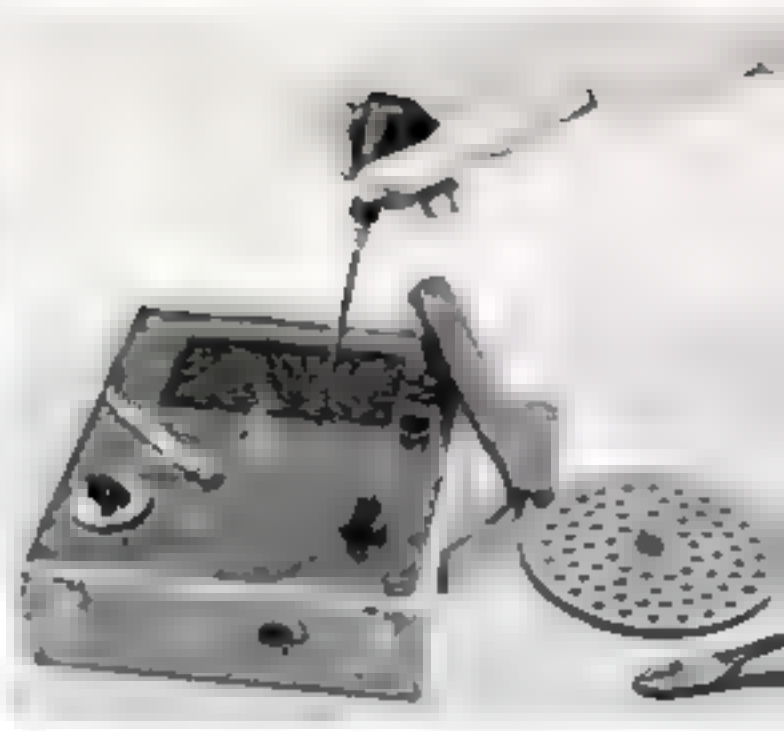
Above is a complete wiring diagram for the radio receiver, showing connection with the phonograph, and below, a pictorial diagram showing placing of parts of both the radio and phonograph attachment



tween grid and ground. The antenna is connected directly to the grid of the first 1T4, and may be any length from 12' to 28'. No ground is necessary.

Small, shielded iron-core coils, 1⅝" in diameter, couple the RF stages, and these are tuned by a midget two-gang tuning condenser. A 100,000-ohm variable resistor, in series with the screening grid and plate of the 1T4, controls the volume for radio recep-





Above, the top of the control panel with the record turntable removed. This gives a view of the opening for the speaker, in the rear, and the speed regulator under the turntable

Bottom view of the radio phonograph. The radio chassis, turned over on its side, fits snugly into the space left by the phonograph mechanism. The record player is spring-driven; the two batteries are for the radio

tion. Another variable resistor, in the grid circuit of the 3Q4, controls volume for the phonograph amplifier and pick-up. For radio, this is left at its maximum position.

Because of the size of the unit, a 6" turntable is the largest that can be used. One 8" in diameter would entirely cover the top panel, leaving no room from tuning or volume controls, and would completely hide the speaker.

For the same reason 2½" of the tone arm of the 9" crystal pick-up must be sawed off, reducing the length to 6½", a size that would fit inside the case. This does not impair the performance of the pick-up—the quality of the output being just as good. (When playing recordings, do not use a loud needle as this will overload the 3Q4, causing distortion in the reproduction of sound.

Wire soldered to paper clips makes connection to flashlight batteries

Inserted in the audio stage is a S. P. D. T. radio-phonograph switch. This is of the rotary type and is mounted in front of the panel to balance up with the small 1¾" tuning dial.

The case is constructed of ¼" thick white pine and is covered with tan airplane cloth fabric, which can be obtained in small rolls. Removable hinges are used, but they are not essential.

The panel is made from a piece of plywood, also ¼" thick, and given a high-gloss finish. The size of the panel is 9" by 8". An oblong hole 5¼" by 2¾" serves as an opening for the 4" speaker.

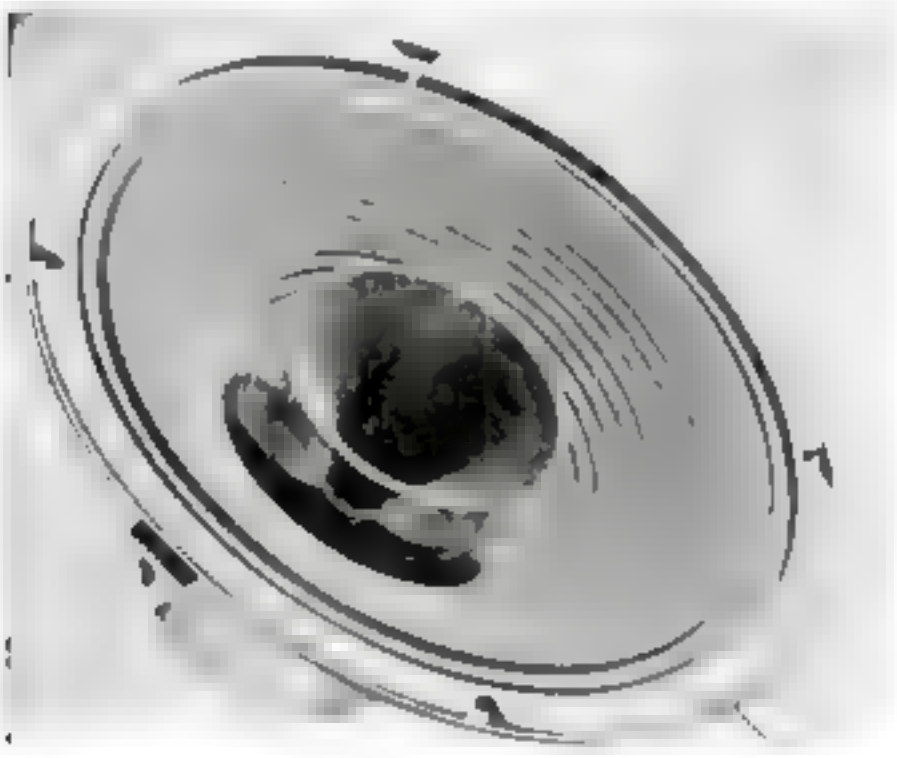
For outings, or carried from one part of the house to another, this set will give good service.

LIST OF PARTS FOR PORTABLE RADIO-PHONOGRAPH

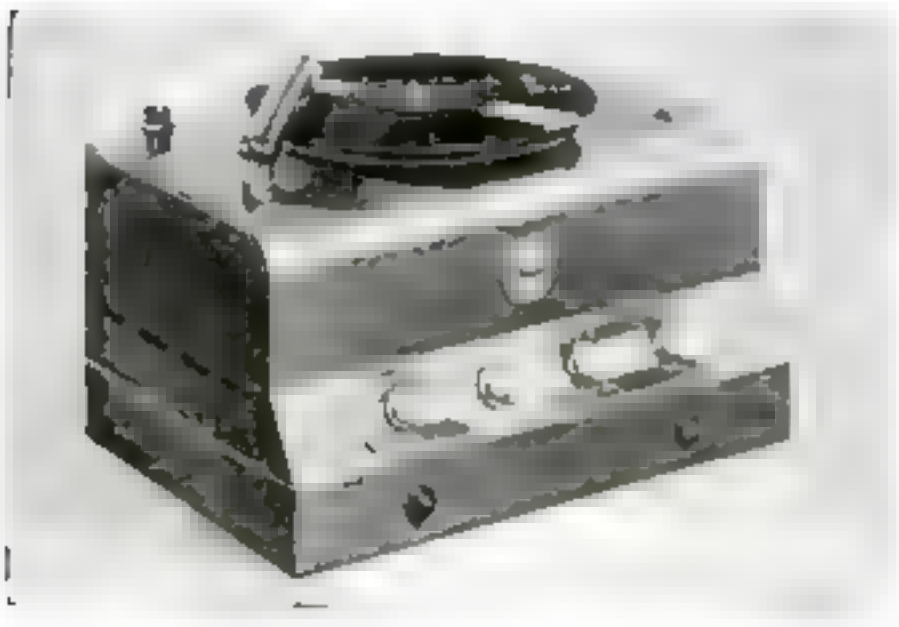
Metal chassis, 6" by 2¼" by ¾".
Two-gang tuning condenser, .00036 mfd.
RF coils (2), iron core, shielded.
Midget tuning dial.
Volume controls: (for pick-up) 1 megohm; (for radio) 150,000 ohms.
Switches: attachable, D. P. S. T.; rotary, S. P. D. T.
Miniature seven-prong wafer sockets.
Tubes: super-control RF amplifier pentodes (3), 1T4; beam power output, 3Q4.
Permanent magnet speaker, 4".
Midget output transformer.
Spring-wound phonograph motor.
Crystal pick-up.
Condensers: paper tubular (3), .01 mfd., 400 volts; paper tubular, .002 mfd., 400 volts; mica, .00025 mfd.; mica, .005 mfd.
Carbon resistors, ½ watt (3): 75,000 ohms; 500,000 ohms; 5 megohms.

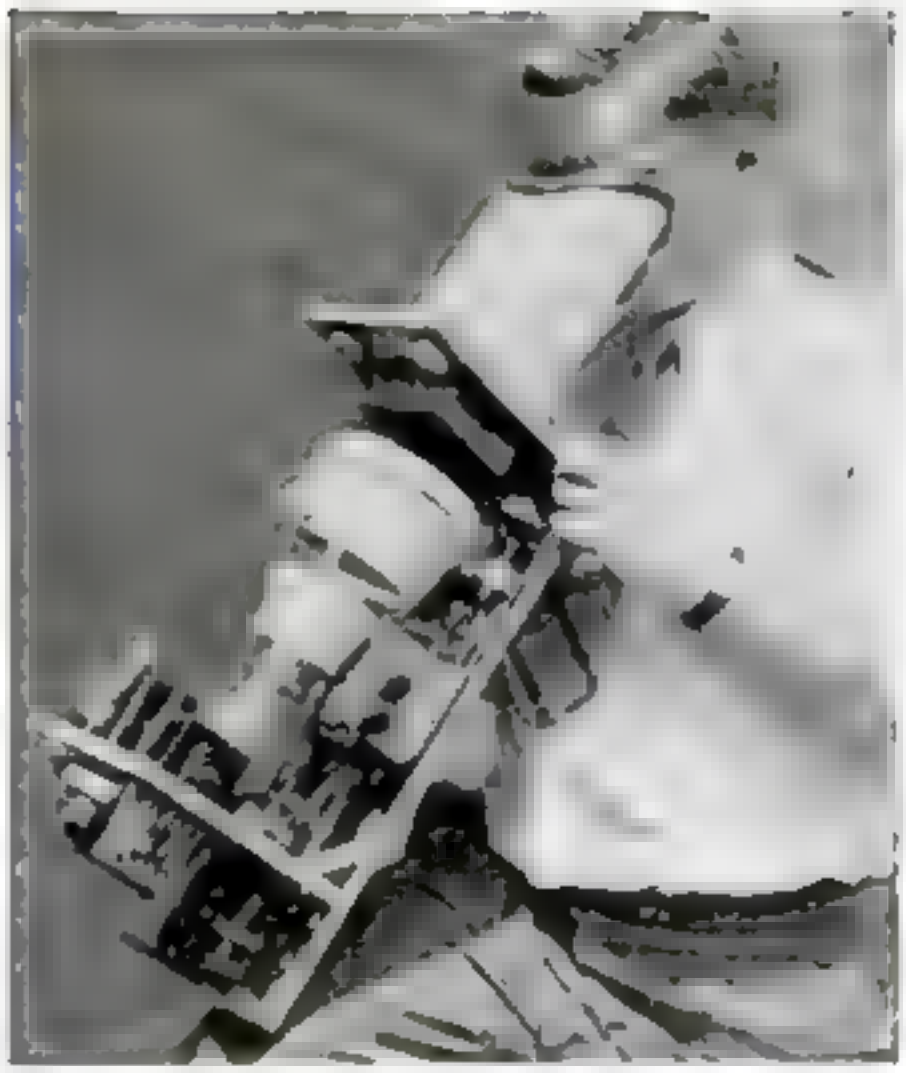
Radio Ideas

DIFFUSING CONES are now being built into the loudspeakers of frequency-modulation receivers to assure even distribution of tones throughout the room. With the new FM reception, there is a tendency for high notes and overtones to focus in a single beam projecting straight out from the speaker. A diffusing cone (below) overcomes this and assures uniform fidelity of tone in all directions from the speaker.



RUGGED CONSTRUCTION and adaptability to a variety of operating conditions are combined in the new low-cost 25-watt amplifier shown below. The unit, without frills and useless gadgets, is inclosed in a furniture-steel case only 12 inches high. The built-in phonograph can be used simultaneously with a microphone. A continuous musical program can be provided by plugging in an external phonograph and fading from one to the other.





AN ELECTRONIC VIEW FINDER has been introduced to simplify the job of the television cameraman. Replacing the old optical finder or peep-hole focusing technique, the new view finder reproduces exactly the image being picked up by the television camera. A five-inch cathode-ray tube operated by an independent power-supply unit provides the image. An eye shield prevents stray light from interfering with the image on the tube

THE LOWLY SUCTION CUP has answered the long-standing radio problem of securing faithful reproduction of the tones of musical instruments. A new compact crystal microphone unit provided with such a rubber cup is snapped on and off the desired instrument in an instant. The cup holds the mike securely without altering or mutilating the tone of the instrument in any way. Only an inch in diameter, the unit also can be used for speaking and singing. It works directly into the grid of the radio set and requires no matching transformer.

Pictures of great beauty and rare y approached photograph'c qual ty are taken with multiple flashes. In this study of his daughter by the noted photographer, Torkel Korling, there is none of the flatness usually associated with flash pictures—multiple flash prevents that. Korling uses two flash lamps with a 4 by 5 Graflex or Speed Graphic for most of his work with children and pets one lamp on the camera, the other on an extension cord, and both synchron zed w th the shutter

Flash Lamps

RATIONED LIGHT FOR PHOTOGRAPHY

By Henry M. Lester

Editor *Photo-Lab-Index*, and co-editor and publisher, *Leica Manual*, *Miniature Camera Work*, and *Graphic Graflex Photography*

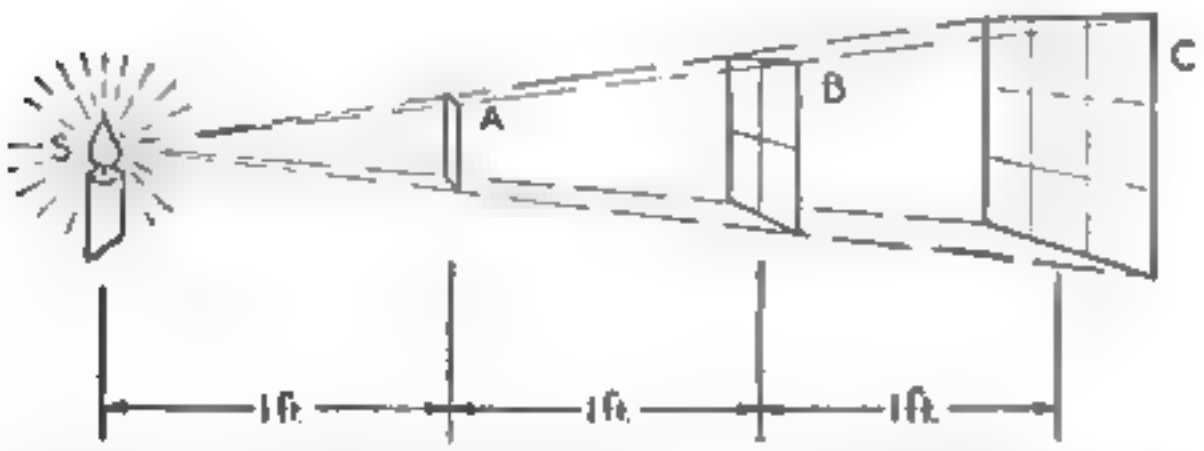
One of the most difficult subjects to photograph is a cat. Pets and children move so quickly—but the flash stops them!

ADMITTING through your camera lens just the right amount of light needed to produce a well-timed photograph—no more and no less, and light of just the right quality and at the proper time—is the accomplishment of the modern photographic flash lamp. This efficient illuminant actually rations the light with unbelievable accuracy, cleanliness, and in an abundance which would hardly be expected of a unit so small. Of excellent photographic quality, uniform in its performance, independent of local power supply, operating on the current of ordinary dry-cell flashlight batteries obtainable almost anywhere, the flash lamp is, in effect, "light compressed into tablets." As the lamps are available in various sizes, the problem of adjusting the dosage of light to various requirements reduces itself to the choice of the right flash lamp.

The availability of so many flash lamps and far too many accessory gadgets for their operation, justified possibly by the innumerable applications to which flash lamps are being put these days, makes the matter somewhat complicated, if not downright mysterious, to the uninitiated. To be sure, the timid soul who approaches the subject of flash photography with any misgivings should feel greatly encouraged by the fact that *the flash lamp was given to photographers actually to simplify the making of better pictures.*

Currently there are two distinctly different brands of flash lamps being produced in the United States: the Mazda Photoflash lamps, made by the General Electric Company and the Westinghouse Lamp Mfg. Co., and the Wabash Superflash lamps, made by the Wabash Photolamp Corp. Between them, these two brands account for a total of 22 different types of flash lamps. Several among them are just slightly different from each other, and their performance characteristics place them in the same general class.

Roughly then, these 22 flash lamps, overlapping as they do, can be divided



Inverse-square law of illumination: Area A, a foot from light source S, receives four times the intensity of light as an area of similar size two feet away (at B), and nine times as much as one three feet away (C)

into three groups—amateur, news photo, and special purpose—and thus narrows down the field to a point where it can be much more easily understood. The table given here classifies them according to their accepted use.

GROUP	MAZDA PHOTO-FLASH LAMPS G. E. and Westinghouse	SUPERFLASH LAMPS Wabash
1 Amateur	"8M", 5, 6, and 11	0, Press 25, and Press 40
2 News photo	16A, 21, and 31	Press-50, 2, and [illegible]
3. Special purpose	50 and 21B	3, 3X, 0B, 40B 2B, 3B and the "Blackout Lamp"

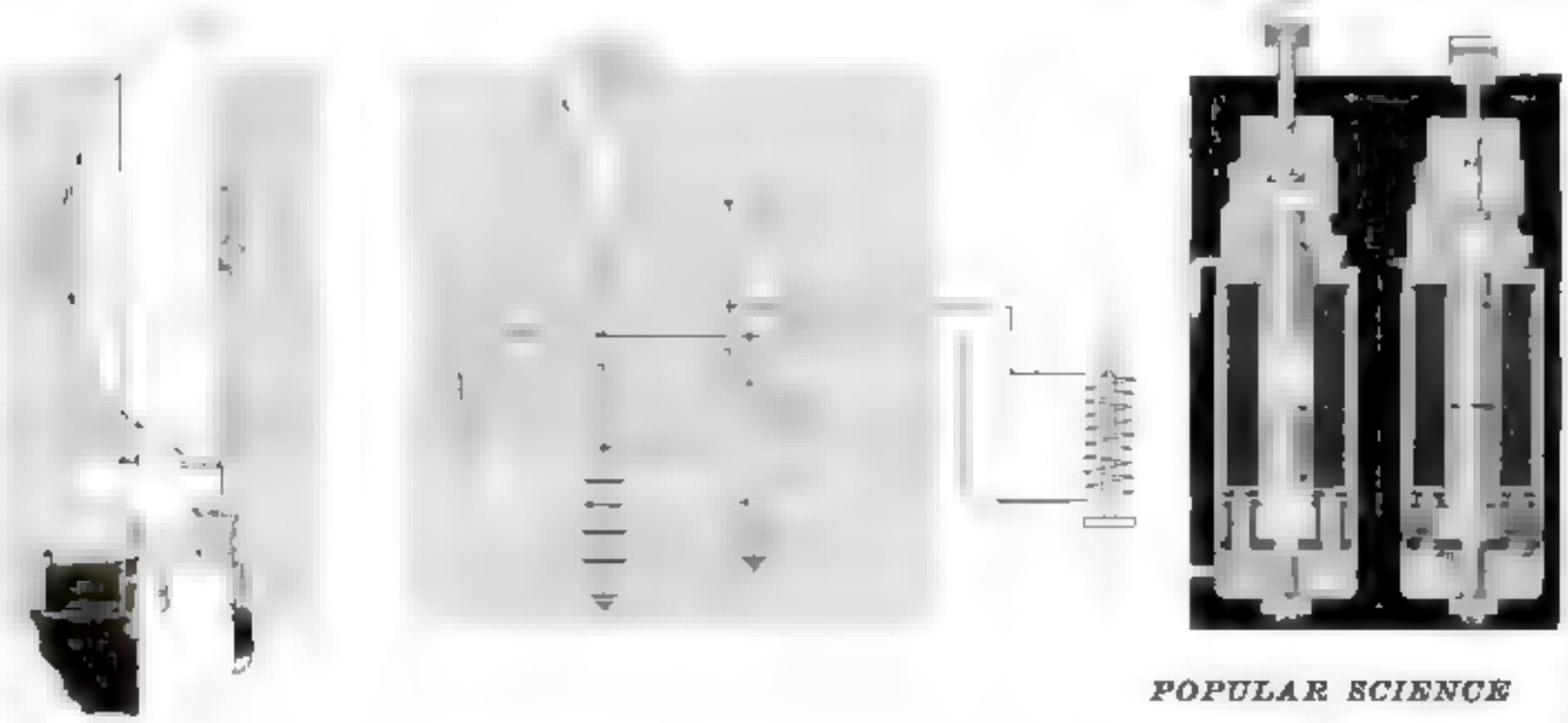
Speed Graphic fitted with a Graflex flash synchronizer, latest version of an important accessory for flash pictures

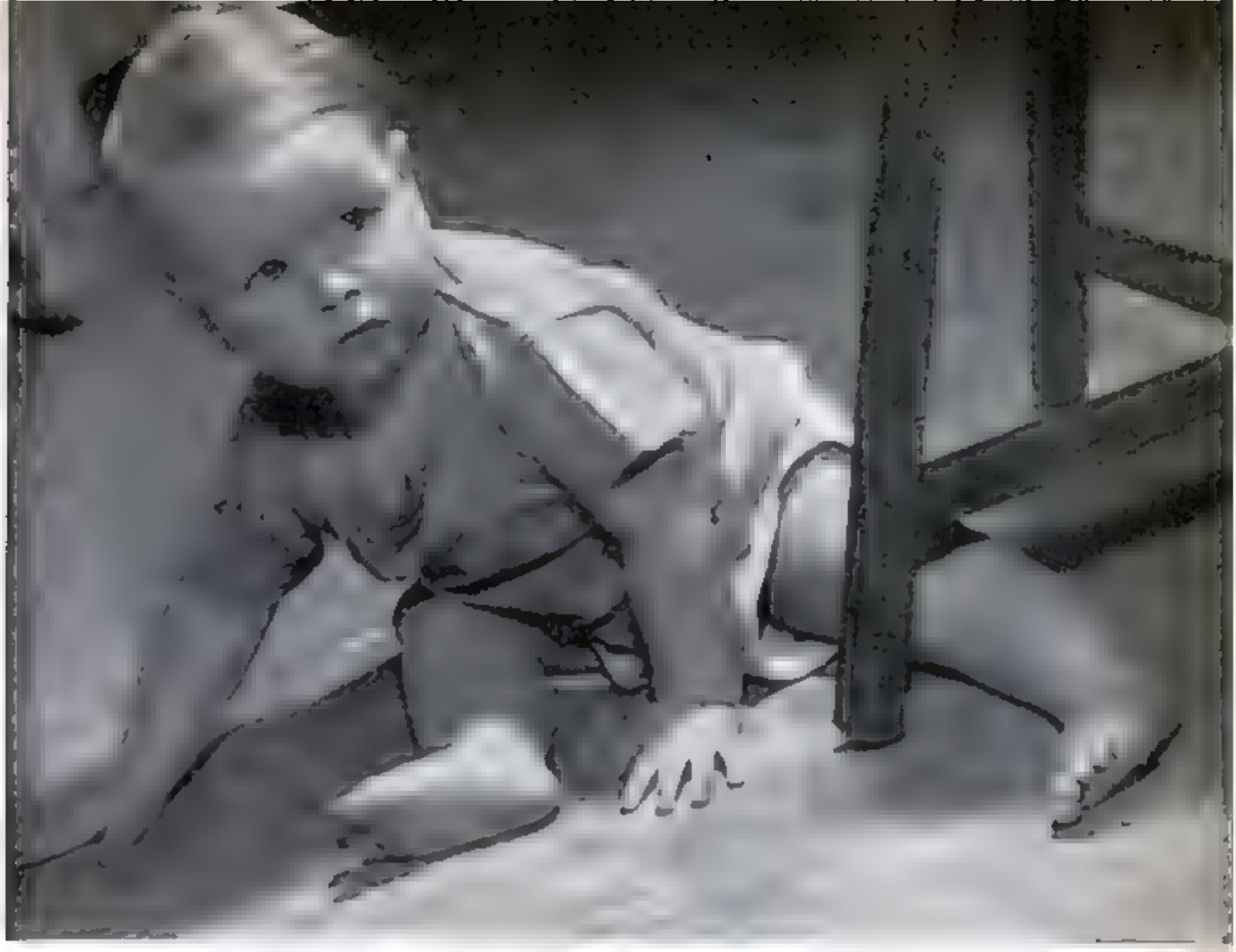
Basically, all of these flash lamps have much in common: any of them will flash on the current of two or more dry-cell batteries; any of them will produce a picture with almost any camera, lens, or film. Outside of that they differ from one another in the total amount of light they emit, the length of time or the duration of the flash, and the quality or color of the light emitted. These differences render these individual flash lamps suitable or not suitable, as the case may be, for use with special cameras, shutters, or films, which in turn are required for varying purposes, the list of which is literally endless in modern photography.

The simplest method of using flash lamps, for which any of them can be employed, is that which, though still extensively practiced, was the only one possible when the flash lamp was introduced some ten or eleven years ago: the shutter of the camera was opened, the lamp flashed, and the shutter promptly closed again. This method provided the full utilization of all the light emitted by the flash lamp. The earliest flash lamps, filled with thin crumpled aluminum foil, flashed in something between 1/25 and 1/50 of a second. It was, and still is, a sufficiently brief interval of time in which to take a picture of someone or something that is not in motion, such as a portrait, a group of people, or a still life.

This arrangement, however, was not satisfactory for news photographers and others who had to take pictures "on the fly" of things and people who could not be asked to pose or even to wait. The necessity for exposures of 1/100, 1/250, and even 1/1000 of a second created a problem of how to arrange for the flash to take place during that very brief moment when the shutter was

Below, left and center, side view and wiring of the Graflex flash synchronizer, one of the features of which is a focusing spotlight just below the flash bulb. At right is a cross section of the solenoid release before and after tripping. Momentum attained before tripping reduces consumption of current



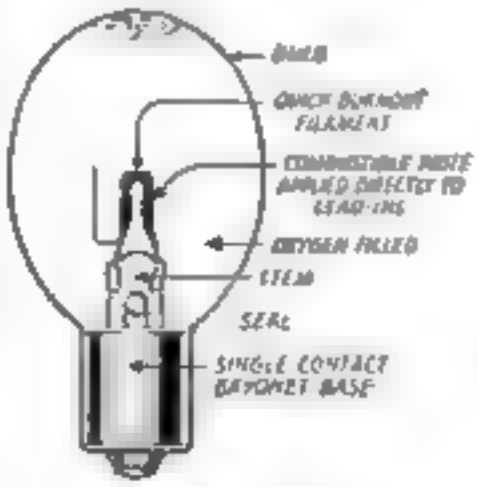


Multiple flash of Korling's son, caught in a natural pose and in a soft arrangement of light and shadow

open. It became obvious that some sort of "synchronization" (simultaneous performance) had to be worked out between the action of the camera shutter and the flashing of the bulb.

The history of "flash synchronizers" is extremely interesting and exciting. It is filled with drama, failures, and successes. The growth of the "synchronizer," or "flash gun" as it is frequently called in the press photographer's vernacular, is the story of a coöperative pull between the various forces whose heart was in the ultimate perfection of the synchronizer: photographers, lamp manufacturers, camera producers, and, of course, the designers of the synchronizer itself. But that story does not belong here. For the sake of clarity, a set of illustrations is being offered to show the component parts and working principle of the latest version of this important accessory: the Graflex flash synchronizer, the performance of which is based on the magnetic solenoid release or "tripper." The function of this is shown in the electric wiring diagram; it "trips" the shutter release at the precise moment that will cause all the "leaves" of the shutter to be open just as the flash of the lamp has reached its peak!

To realize how critical the necessary adjustment and function of the synchronizer must be to perform its function well, it is important to know that the full peak of light emission of the bulb is reached in something like 0.020 second—1/50 of a second—and that due allowance must be made for such factors as the delay in the performance of the shutter and the starting time of the flash.



Construction of an "SM" bulb. The antennalike wire is for use only in the manufacturer's test

The choice of any particular flash lamp, aside from the brand (which is a matter of personal preference), should primarily be based upon the distance of the subject from the light source. Other considerations are: stationary or moving object; speed of film; how fast the lens is (*f*-number); type of shutter; depth of field necessary, and so on.

It should be borne in mind that with any given film, lens stop, shutter speed, and flash bulb, the amount of light reflected by the

subject, reaching the film in the camera, will vary with the distance from the lamp to the subject. (Not camera to subject -but lamp to subject! When the lamp is used on the camera, then the distance is measured from the camera, of course.) This important fact was first given practical application in flash photography by Percy Harris, editor of the British magazine, "Miniature Camera World." He assigned a number, which was originally referred to as the "Harris factor," to each film-shutter-speed-lamp combination. This number, when divided by the *distance in feet* from light source to object, will give the nearest correct lens aperture *(f-number)*. This number is, in this country, called the "guide number" of a flash lamp.

THE use of guide numbers makes flash photography almost automatic. For example, we find a given bulb, with our regular film at a shutter speed of 1/100 second, is assigned a guide number of, say, 155. Then if our subject is ten feet from the flash lamp, the lens setting is found by dividing the guide number 155 by 10'—result 15.5 or practically *f*, 16. Tables showing the guide numbers are available, free of charge, from the manufacturers of the flash lamps.

The right bulb to use for a given shot depends on the subject and the camera. If your camera is not fitted with a synchronizer, almost any hand flash-lamp holder will do, with almost any bulb. Little pocket flash lamps are available for use with the No. 5 and "SM" lamps. The No. 5 or the Press-25 gives more light, but the "SM" has a quicker flash, resulting in less danger of blur should the subject move. Larger hand lamps are generally used with the No. 21 for pictures in larger rooms, and sometimes the Wabash 3 or Mazda 50 for large banquet halls or outdoor shots.

For the little flash-box cameras with built-in synchronizers, the bulb usually recommended is the Mazda 11 or the Wabash 0. Larger lamps will usually cause overexposure, except in large rooms.

For hand cameras fitted with synchronizers, and press-type cameras, the lamps usually employed are the Press 40 and Press 50, and the Mazda 16A. These lamps supply a large volume of light, and, in addition, are somewhat slower burning, so that slight errors in synchronization, unavoidable due to the rough handling newsmen give their cameras, will not prevent synchronization.

Certain miniature cameras, and many large cameras as well, are fitted with focal-plane or curtain shutters. These shutters attain speeds as high as 1/1000 of a second by using a narrow slit in a relatively slow moving curtain. When the button is pressed, the slit travels over the surface of the film, exposing it from one end to the other. The high speeds available with these shutters make them valuable for action work, but special flash lamps must be used if they are to be synchronized. The lamps must burn long enough so that the slit in the shutter can travel the entire length of the film during the peak of the flash. Bulbs of this type are the Mazda 6 and 31, and the Wabash 2 and 2A.

Color film may also be shot with flash bulbs—in fact, one of the best ways of shooting Kodachrome, because of the accuracy of the exposure. Any flash bulb may be used with indoor type film. For use with outdoor type—film intended to be exposed in daylight—or for balancing flash with daylight coming in through windows, for example, using outdoor type film, a special blue-coated bulb, giving light of daylight quality, is used. Bulbs of this type are the Mazda 21B and Wabash 0-B, 2B, 3B, and 40B.

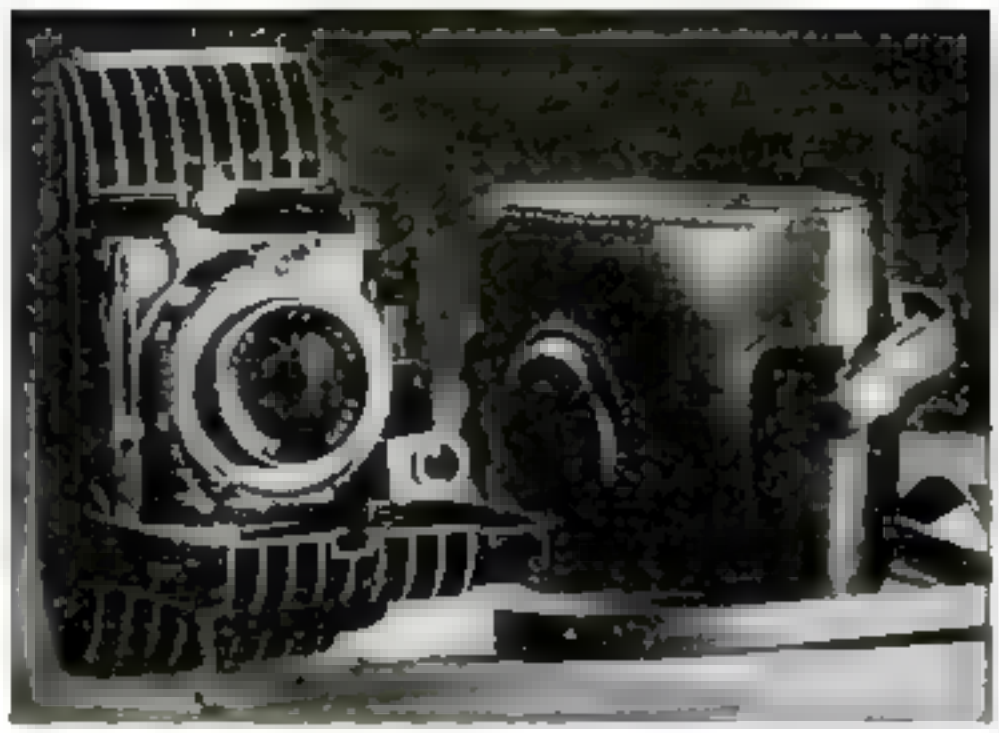
The latest development in flash bulbs is one that can take a picture in a dark room with the subject completely unaware of the flash! It is the so-called "blackout" bulb, by Wabash (see P.S.M., Oct. '41, p. 229).

All of these bulbs, with one exception, work on the same principle—the battery current ignites a small primer, which in turn fires the filling of aluminum wire or foil, producing the flash. The exception is the "SM" bulb, which contains a small blob of active material on the lead-in wires, and an atmosphere of oxygen in the bulb. The construction of this bulb is shown in an accompanying diagram. The long, antenna-like wire inside the bulb serves as an aid to testing the bulbs during manufacture and has no other function. The interesting thing about the bulb is the extremely short duration of the flash—0.005 second. Thus, using the "SM" bulb without a synchronizer, even the cheapest camera can take action pictures as if its shutter speed were 1/200 of a second.

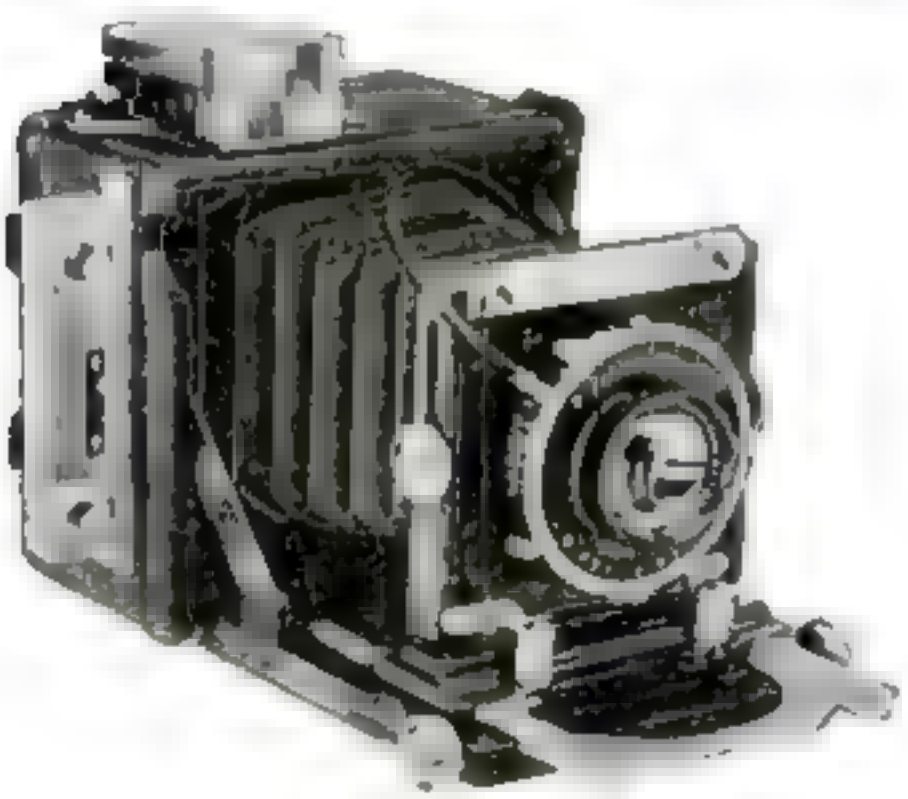
By placing two, three, or more flash bulbs in positions where they will produce desired gradations and high lights or illuminate dark shadows, one achieves remarkable effects. At the same time, the great brilliance of flash lamps permits working at small lens apertures, resulting in brilliant, sharp pictures, full of detail.

The illustrations shown here are multiple flashes by the noted photographer, Torkel Korling, who through long experience has learned to produce flash pictures of great beauty and rarely approached photographic quality. Here is none of the "flatness" usually associated with flash pictures—multiple flash prevents that.

NEW CAMERAS

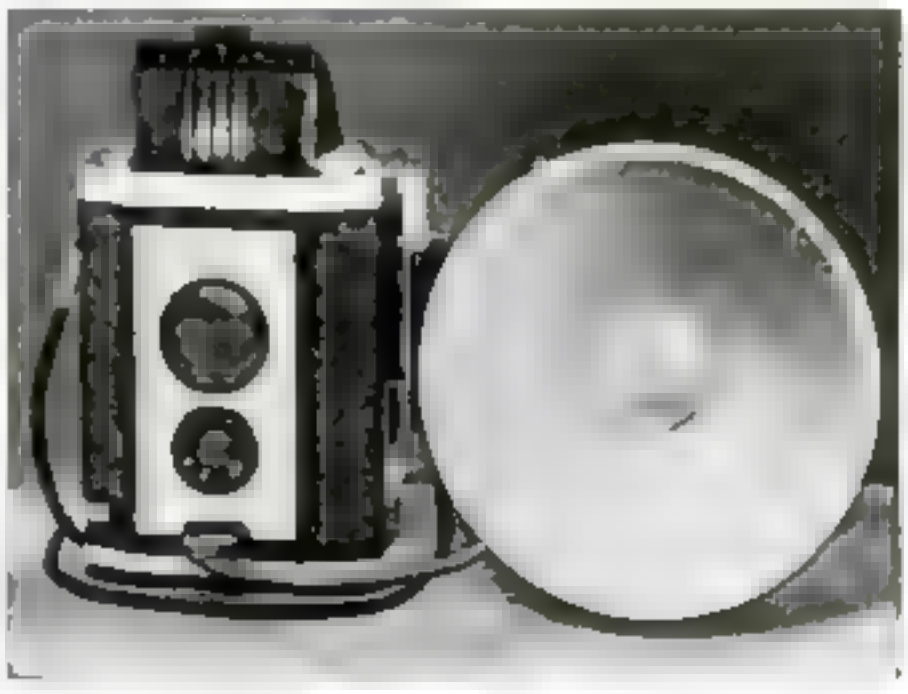


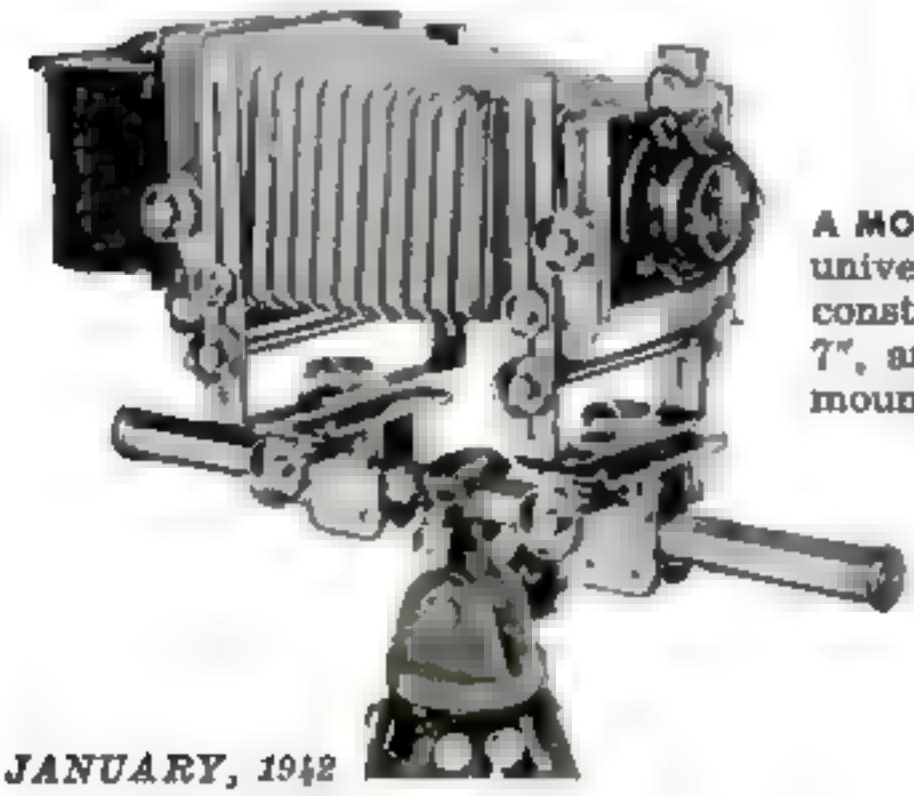
A NEW BANTAM SPECIAL is on the market, equipped with Kodak Ektar f/2 lens and Supermatic shutter. Aberrations—coma, astigmatism, distortion, curvature of field, and spherical aberration—are virtually nonexistent in this lens. It also has been corrected for lateral and longitudinal chromatic aberrations to make possible Kodachrome transparencies of hair-line sharpness. Surface coatings only 1/50,000" thick on the inner glass-air surfaces of the lens elements still further improve the clarity and brilliance of the images formed.



A MINIATURE PRESS CAMERA is now being manufactured in the 2¼" by 3¼" size (above). It is a small edition of press cameras and has similar adjustments. The telescopic eye-level view finder is adjustable for correction of parallax on close-ups. Standard press accessories may be added.

FOR THE BEGINNER who desires an inexpensive camera for taking indoor pictures by synchronized flash as well as outdoor pictures, the popular twin-lens reflex camera shown below is now being offered in what is called a "synchro model." The flash holder, consisting of battery case, polished reflector, and lamp socket, is attached to the side of the camera case, and the connecting cord plugs into terminals in the front plate under the lens. This attachment is designed for the new SM (Speed Midget) photoflash lamps.





A MONORAIL BED is the outstanding feature of a new universal view and portrait camera of all-metal construction, which is available in 4" by 5", 5" by 7", and 8" by 10" sizes. The lens standard, tripod mounting plate, and camera back are mounted on a single hexagon-shaped rail, the bearing surfaces of which provide slip-proof traction for the friction focusing drive. Operating adjustments on both lens front and camera back include rise and fall, side shift, swing, and tilt in a wide range.

This title was obtained by dissolving the word "showmanship" over an illustration. The picture was taken in a 5' fade-out with closed shutter, the film wound back 5', and the word faded in. The sample is the work of George L. Lancaster

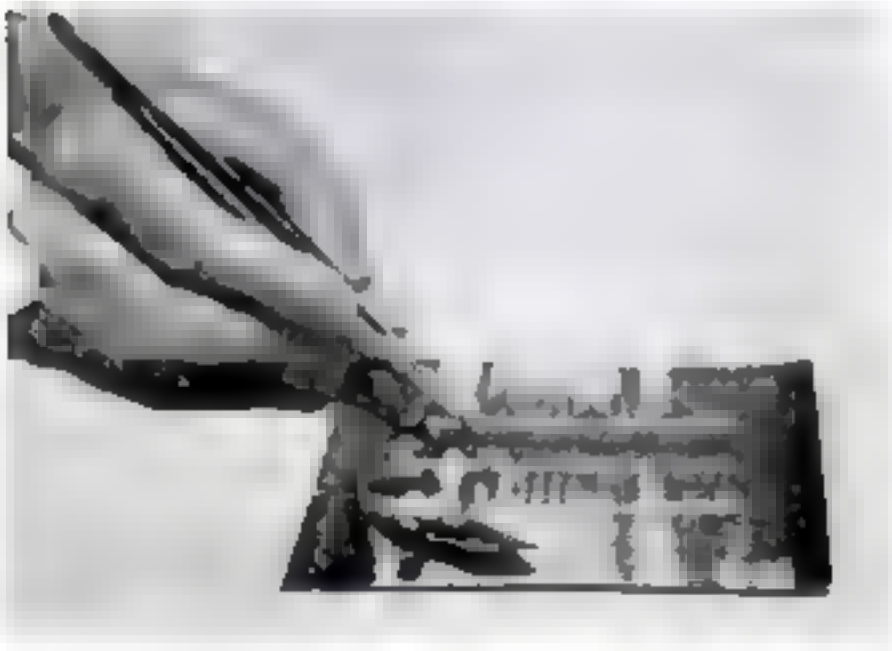
By
CHARLES G.
CLARKE
A. S. C.

As a governor of the American Society of Cinematographers, Charles G. Clarke has long led in the development of photography. A recent achievement is the artificial cloud transparency (see page 101). In 25 years he has filmed "too many pictures to count," among them several of the Zane Grey series, "Dead Men Tell" (a Charlie Chan thriller), and "Cadet Girl."

YOUR picture making has scarcely begun when you view the uncut scenes taken on last summer's camping trip or at this fall's colorful football games. As the cold of winter drives you indoors, the real thrill of movie making lies ahead. I'm not talking about filming indoor scenes, but refer instead to the important task of editing and titling the haphazard collection of celluloid lying around in cans awaiting your attention.

Title making is more fascinating to me than shooting the scenes those words are intended to explain. You can do wonders with titles. They challenge your ingenuity, and if you aren't careful, your pocketbook. But there's a way out. You need not spend a handful of dollars to achieve interesting effects. From my experience I've collected several timely tips, all of them economical. By following them you will gain new interest in your avocation.

WHAT TO SAY. Titles serve several functions. They quadruple a picture's interest by interpreting and describing the action and scenery, and by serving as speeches for



Gummed letters in sets simplify the job of title making. Use tweezers to fit them into straight lines. Glue will hold them in place permanently

When white letters are placed over a photograph or post card, the light parts of the background must be darkened with ink or pencil for contrast

your characters in silent films. Plainly state the facts. Use no more words than necessary. I've found it a good plan to scan newspaper headlines, then try to write my titles in the same vein. Short titles are easier to read and require less footage; long titles tend to destroy interest in the scenes themselves. Should the action force an especially long explanation, break the titles into three or more parts, dissolving from one to another.

TITLE FOOTAGE. In general, allow one full second for each word. If this seems too long or too short, read the title from the screen while the machine runs and cut it to fit a "normal" reading time.

ARRANGEMENT. Never carry your titles to the very edges of the screen. By grouping the words compactly near the center, you avoid the possibility of "bleeding" them off the fringes. Also, a well-knit group minimizes errors in centering and aligning them.

GUMMED LETTERS. These glossy white letters and figures come in sets of various dimensions. Their use avoids time-consuming hand lettering. The size to be chosen depends upon the "screen" on which they are pasted. A title measuring 9" by 12" may be made with letters ¾" or 1" tall, while a 3" by 4" title requires letters from ¼" to ½" high. The letter sets are available nearly everywhere, and I've found them decidedly useful.

Since many of your scenes are records of vacation trips, it is a good plan to buy picture post cards of each locality you photograph. When you are ready to start titling, spread a selection of cards on the table and pick out those that seem most appropriate. Remember, you're using white letters, so be sure to spray a little black ink over light areas of the post cards, or shade the areas around the letters with a soft pencil. Of course, you'll mark off the lines with a ruler before starting, because when projected the error of off-center and out-of-line letters is magnified many times.

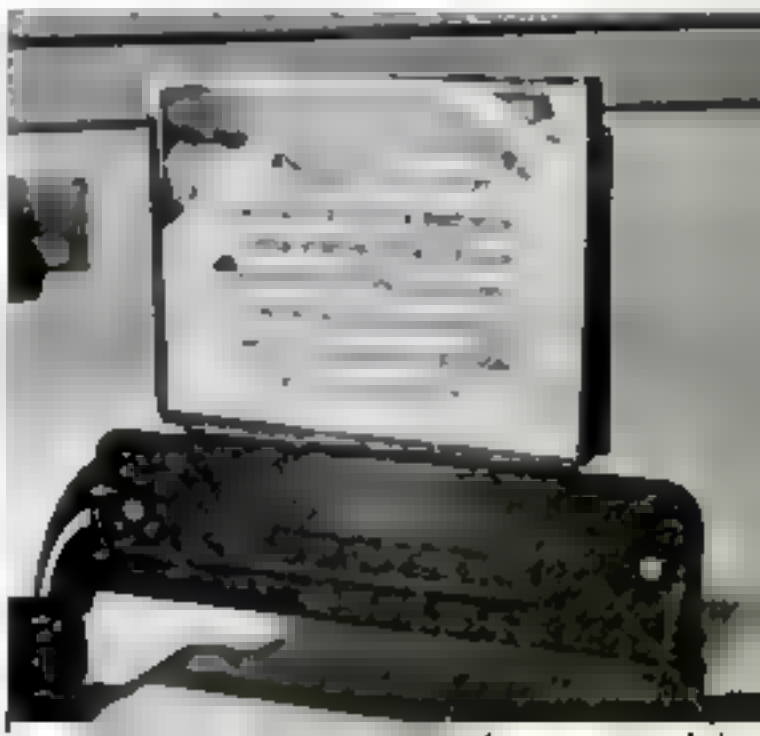
DISSOLVES AND FADES. Opening titles should dissolve over each other, and both titles and background fade in and out simultaneously. Here's the method I use, employing white letters on black cards and a plain picture background. The effect can be duplicated with any camera.

You'll find perforated figures from the end of the safety leader about 5' into the film. These indicate the start of the exposable film. Load the camera as usual. Remove the lens and run the film until you see the perforated figures through the aperture. Set the counter at zero, replace the lens, and photograph the first title. Allow about 2' for each fade. Let's say you fade in from 03' to 05', and out from 07' to 09'. These fades may be accomplished by starting with the iris diaphragm closed, and opening gradually until you reach the selected stop. To fade out, you reverse the process.

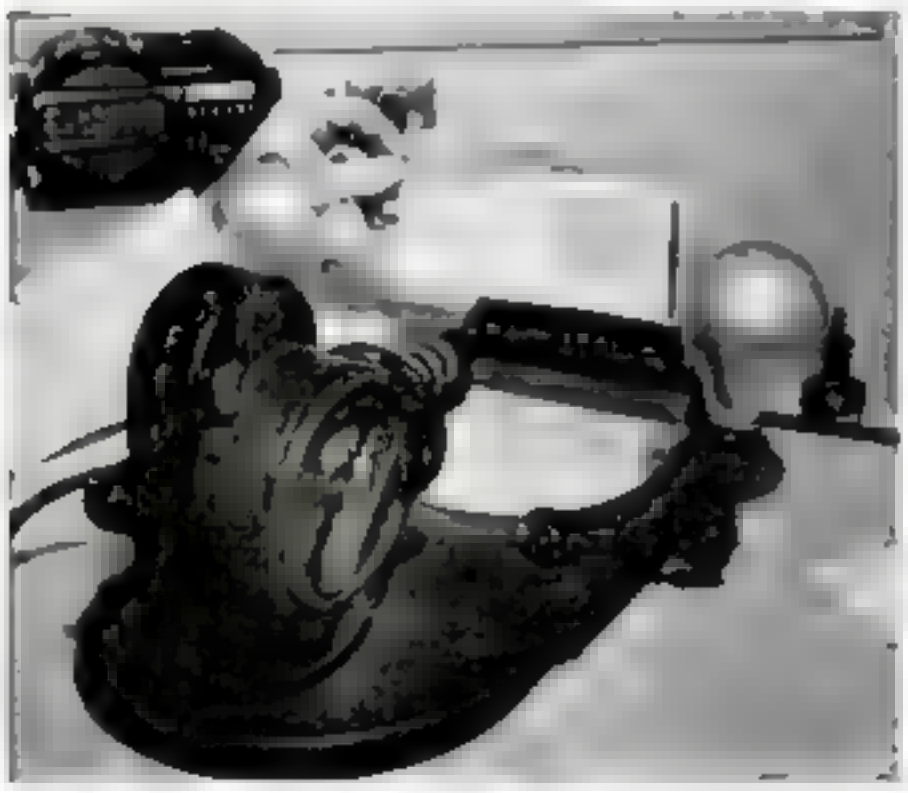
After completing the fade, open the camera in complete darkness, and wind back the film onto the unexposed reel. Reload, run the leader through until the footage figures appear, set the counter at zero, close the diaphragm, and now run the film up 3'. Place the camera in front of the second title. For best results, overlap the fade an additional foot. Thus, you start opening the diaphragm at 6' and have it wide open at 8'. Repeat the process for each title in the series.

Now place your photograph or post card in the holder, wind the film back on the starting reel, reset the counter to 00, and start the camera with the diaphragm closed.

In copying titles, set up the camera and titling stand at a convenient angle. Left, this is being done on the kitchen table. Below, close-up of typewritten title on a picture background



For a scrambled-letter title, the letters are tapped into a jumble as they are being filmed. The film, of course, must be run backward in the projector



To get a "wipe" effect, a white card in front of the title is drawn away (to the side or up) after the camera starts, and then moved into place again

Gradually open until you reach the predetermined stop, and let the camera run until you fade out 1' beyond the last title. That extra foot is important, because the white letters will be visible longer than the darker background.

ACTION BACKGROUND. Hollywood producers have achieved near perfection by photographing actors in the studio against moving backgrounds taken, perhaps, on the other side of the world. Your set-up is simple compared to our elaborate professional arrangements. Select from your library a scene devoid of white areas, or space your title lines so they do not overlap into the white. Place within the title stand a piece of ground glass cut to fit. This can be arranged by trimming out the metal back from the title holder. Now set up a projector and the camera so both are in perfect line with the center of the ground glass.

After projecting the scene on the glass, focus the camera sharply on the image. Since the projector and camera shutters will not synchronize to a split second, take the pictures frame by frame, first setting a frame from the projector, then exposing one frame in the camera, repeating the process throughout. Remember, too, you are exposing this action on film previously exposed to white letters on a black background. The result will be a pleasing flow of scenery or action behind the crisp words.

CONTROLLED BACKGROUND. Not always do you find among your celluloid souvenirs appropriate scenes for title making, yet you may desire a special projection print. Lovely effects of color in motion may be obtained by reflecting masses of colored light on the ground glass.

If you want to manufacture your own background, slip a small, flat "aquarium" into the holder. By this means, you can photograph tropical fish, butterflies, and other natural-history subjects. You'll get good close-ups, always in focus.

More simple than any of these ideas is the photographing of title letters and moving background simultaneously outdoors. The letters should be glued to a piece of clear glass, which is placed in a mount fixed to the camera. If both the background (children at play, trees waving in the breeze, and the like) and the letters are well lighted by the sun, you can stop down the diaphragm sufficiently to catch the background pin sharp and the letters reasonably so. This method provides an interesting variation.

SUBTITLES. A picture background should be used to introduce, first, the film as a whole, and second, divisions or chapters where the action, locale, or time changes. For the running titles, I have found ordinary typewritten capital letters on plain white paper not only photographically excellent, but also most economical. For this purpose you must use positive film. By developing "straight" with contrast developer, you get

So-called "process projection" can be accomplished simply by filming while projecting a moving or still background scene against a sheet of ground glass in the title frame

Natural-history subjects may be used for interesting backgrounds by fitting a small, flat "aquarium" into the title frame

a negative image showing white letters on a dark background. By splicing this positive into the reversal film, the words will appear right side up and in order on the screen.

'WIPES.' Were you to attempt a fade with black-on-white, using negative film, you'd find the film changing from clear transparency to dark as the title appears. Thus you would reverse the desired effect. As a substitute for the orthodox fade, you might try a "wipe." Simply start the camera with a white card covering the title. Slide the card out sideways or up, and at the proper time move it into place again. Thus you "wipe" the title in, then "wipe" it out again.

Title making isn't easy. Getting effective results will tax your skill, but good titles pay big dividends. They'll turn a mixture of unrelated scenes into a story your friends and family will view with enthusiasm.

WEIGHING CHEMICALS WITH COINS [PHOTOGRAPHY]

In the absence of a set of regulation weights, coins in good condition can be used to weigh photographic chemicals. The table that follows gives the weight of U S. coins in both grains and grams, and, in parentheses, their weight in grains in round figures for easy computation. General photographic formulas, with the exception of ultra-fine-grain formulas, permit an error in compounding up to 10 percent in both weights and measures, and the round figures, falling well within the permissible 10 percent, may be used in all but the most exacting work.

COIN	GRAINS		GRAMS
Dollar	412.5	(400)	26.7
Half dollar	193	(200)	12.5
Quarter	96.5	(100)	6.25
Nickel	77	(80)	5
Penny	48	(50)	3.1
Dime	38.5	(40)	2.5

437 5 grains (gr.)—1 oz.

16 oz.—1 lb.—7000 gr.

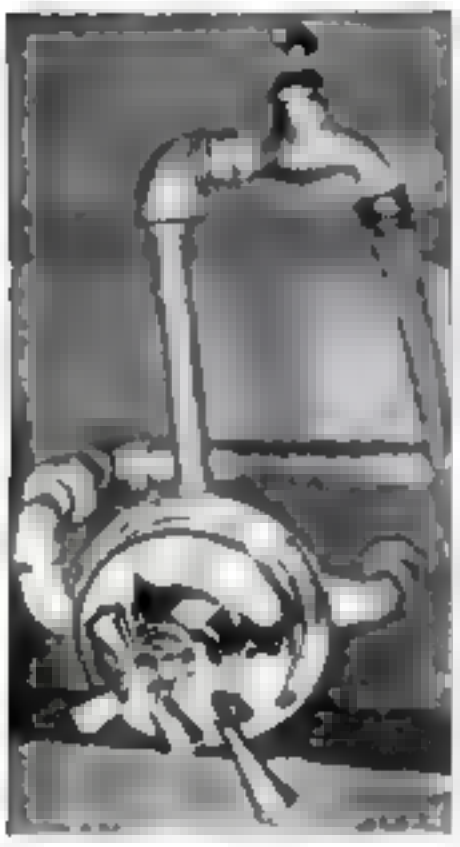
Two fifty-cent pieces and a dime weigh approximately 1 oz.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Milk-Bottle Cover Protects Projector Lens from Dust

A SIMPLE and effective method of protecting the lens of your home slide projector from dust and minor abrasions when not in use is to cover it with a transparent flexible bottle cap. These are provided with an elastic band, which will fit the lens barrel snugly. They may be purchased in various sizes in most ten-cent stores.—E. J. EISENMEIER.

Shower Mixing Valve Controls Temperature of Film Tank

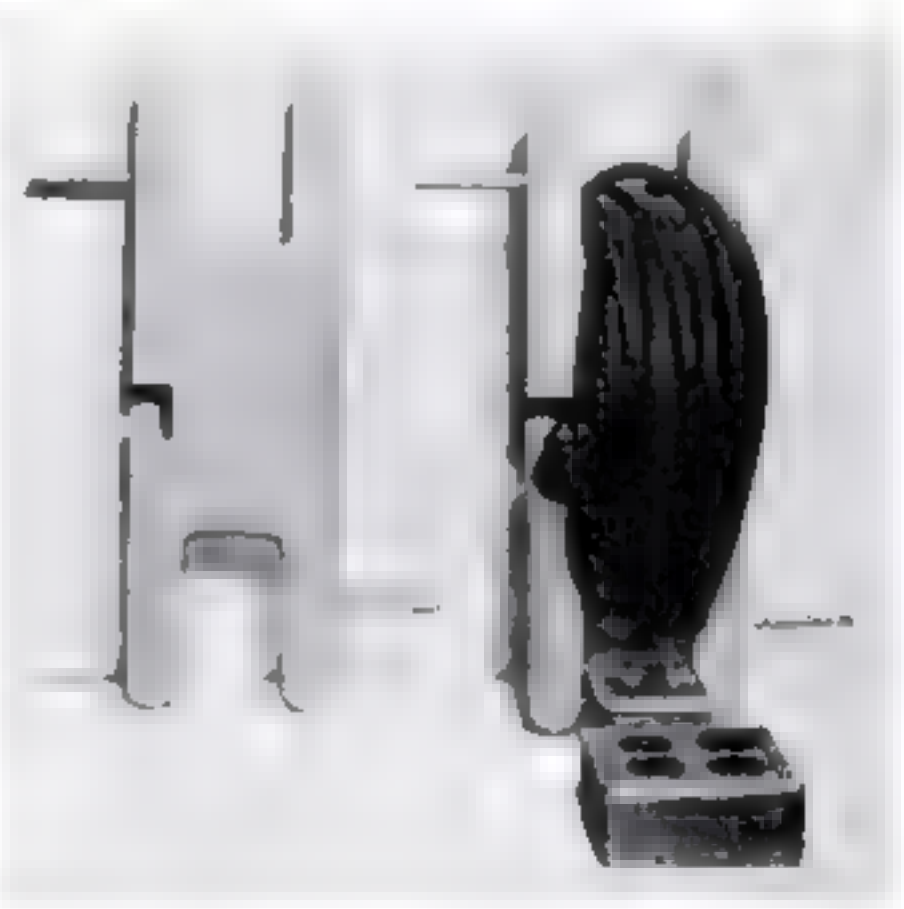


Thermostatic shower mixer and faucet fitted to the pipes that supply water to the developing tank jacket

A SHOWER mixing valve with a thermostatic element incorporated in it will provide a constant-temperature water supply for the water jacket that is often used to surround photographic developing tanks. This mixing valve costs less than half as much as a regular commercial thermostatic control and works well enough for all practical purposes, holding the temperature within a degree or two. A faucet fitted into the outlet pipe makes it unnecessary to turn the valve on the shower mixer, which might disturb the temperature setting.—C. C.

Cable Coiled on Plywood Forms

THE photographer will find it easier to carry about long lamp cords if they are coiled compactly on H-shaped plywood forms as shown below. Round all the corners to prevent abrasion of the cord surface, and fit two handles, which may be short pieces of dowel, to opposite ends so that the cord may be wound up easily with the two hands. An L-shaped notch holds the end of the cable.



Handles on opposite ends and sides of plywood H's enable the forms to be rotated for quick winding

Indicator for Developing Time

WITH the pointer shown, an ordinary alarm clock may be used to time the development of films to the exact minute. A strip is cut from an enameled section of tin can, shaped to a point at one end, and bent as indicated. A rubber band snapped around the case of the alarm clock holds the marker at any desired point.—ROBERT SCOTT.

Snapshots_the biggest Holiday sport

OUTDOORS

Use Kodak Verichrome Film for your pictures outdoors in winter. It brings extra assistance—helps overcome small exposure errors, extends the "snapshot day," lets you get swell snapshots even when the day is dull. Load up now with Kodak Verichrome Film.

SNAPSHOTS, SNAPSHOTS EVERYWHERE . . . the youngsters home from school . . . the oldsters coming together for family reunions, the Christmas tree, the gifts, the parties . . . Perhaps there'll be snow and skiing . . . a freeze and skating . . . and then what snapshots you'll get; some of the grandest of the year.

A Christmas stored safely away in snapshots is a Christmas you'll never forget; keep your camera busy right through the holidays . . . Eastman Kodak Company, Rochester, N. Y.

INDOORS AT NIGHT

Extra-fast Kodak Super-XX Film makes snapshots indoors at night with Photoflood bulbs and inexpensive reflectors. A fascinating sport for your camera. Simple directions in free booklet . . . also tells about flash pictures. At your dealer's.

Outdoors . . . Indoors—you can always count on KODAK FILM

Gus Settles an Account

(Continued from page 144)

"Huh?" Wally said. "Oh—I getcha." He looked at the speedometer. "A couple of hundred over 35,000."

Gus walked around to the front end and examined the bumper. Scratches showed that the license plate had been moved from the right side to the center. "That cuts off some air," he said. Then he knelt down and looked through the radiator grille. "That's funny," he said. "I can't see a thing."

"What should you see?" asked Wally.

"Light. Specially with the hood raised," Gus replied. He got up and looked down behind the grille. A large, oblong piece of black cardboard was leaning close up against the grille. With a slight pressure, Gus shoved it back and it almost completely covered the front of the radiator.

"By gosh. That guy who put in the new fan belt and then fixed this car so it wouldn't run too cool sure *fixed* it!" he said. "I don't think this car ran too cool anyway. The fellow probably never gave it time to warm up. Now, the minute the engine starts, the fan pulls the cardboard back against the radiator and shuts off *all* the air. Maybe that mechanic should be fired, like Pickett said."

About closing time, Joe Clark came into the shop after the day's time-and-material slips, and was surprised to find his partner looking decidedly crestfallen. Joe picked the slips out of the cigar box in which Gus drops them. "What the devil is this?" he yelped after a few seconds. "'One pair of pants, $1.79.'" He read the name and address at the top of slip. "Robert J. Pickett, hey?" he said. "He's a big shot. But what about the pants?"

"They're those no-good fishing pants I bought in one of Pickett's stores last summer," Gus said grouchily. "I've always been sore about them, and when Pickett came in here today with his radiator steaming I saw a chance to get even. So I put 'em on his bill."

Joe looked shocked. "What did he say when he saw that item?" he asked.

Gus's face got red. "Not a word." Then he had to laugh. "Robert J. Pickett is quite a boy," he admitted. He just talked along for a while about how successful he had been running a strictly cash business. Then he got into his car and stepped on the starter.

"'Wait a minute,' I told him. 'You've forgotten your bill.'"

"'No, I haven't forgotten it,' he came back at me. 'And I haven't forgotten that pair of pants you've put on it. Charge it, brother—and try and get it!'"

2 BIG HELPFUL WORKSHOP BOOKS—FREE!

It's Fun to Build a Casco Project!

Casco plans make project-building easy and foolproof. They're complete and detailed, drawn by experts especially for home craftsmen.

And when the job's done, you have an exclusive, original furniture design by one of these famous American designers Gilbert Rohde, Russel Wright or Herman Hjorth ... as fine a design as you could buy. It's *worth* your effort.

How to get Free Plans: First, use coupon below and get your copy of the new Project Book picturing 24 Casco Projects. Select the one best suited to your home.

Then use the certificate found in every 25¢ (or larger) can of Casco Powdered Casein Glue or the new Cascamite Resin Glue. Each certificate entitles you to one Free Plan!

Do You Know How to Glue—

...plastics to wood?

...wood to glass?

...How to tighten squeaky and wobbly furniture *permanently?*

...What glue is best for oily woods?

...Best way to glue end-wood joints, mitred joints, scarf joints?

...How to glue two non-porous materials?

The CASCO Gluing Guide saves time and money for every handyman and homecrafter. Takes the guesswork out of gluing with quick laboratory-tested answers to all types of gluing problems. Tells what glue to use — on different kinds of wood or on any of 23 household or building materials.

Check coupon below to get your Casco Gluing Guide.

CASCAMITE RESIN GLUE
For *waterproof* and all outdoor gluing

CASCO CASEIN GLUE
For heavy duty, *water-resistant* gluing

CASCO FLEXIBLE CEMENT
For *odd jobs* and dissimilar materials

At Hardware, Paint and Lumber Dealers

CASCO • CASCAMITE

GLUES AND CEMENTS

CASEIN COMPANY OF AMERICA, Dept. PS-142
350 Madison Avenue, New York, N. Y.

Please send my copy of booklets checked
☐ "Casco Projects" ☐ "Casco Gluing Guide"

*Name*_____

*Address*_____

*City*_____ *State*_____

Save 2¢ — stick coupon on penny post card

Weld It, Says LeTourneau

(Continued from page 57)

ment on order. Welding was cheap and LeTourneau had a profitable competitive advantage over conservatives who stuck to rivets. In 1929 he decided to incorporate as a manufacturer, and put it through just after the stock-market crash. The first year was tough, but after that the big boom in public works made a strong demand for his goods. In 1935 he moved headquarters to Peoria, Ill., nearer the market, and there the plant area rapidly increased to 25, then 75 acres. Hardly had that been started when the Toccoa development began.

The steel housing at Toccoa was first developed at Peoria, to meet an employee need. This kind of house shell is said to be as cheap as, or cheaper than ordinary construction, because one good welder with a couple of assistants can put up a whole house in a few days.

The house unit starts with plates of steel, four by eight feet, of 12 gauge, ⅛ inch thick. These are stamped with an embossed rectangular pattern, and with a one-inch flange all around the edges. Two of these plates are placed back to back, six inches apart, and welded in this position with light diagonal braces, perforated to discourage transmission of heat. These boxlike panels are set up edge to edge, and simply welded along the joints. When they are in position, insulation is forced in under pressure.

Roof panels are made 18 inches thick. This allows for more insulation and also adds strength. A roof of this construction has remarkable cantilever strength and needs only a few light pillars at long intervals to support it. In LeTourneau's five-plane hangar there is only one pillar, which also anchors a roundabout crane.

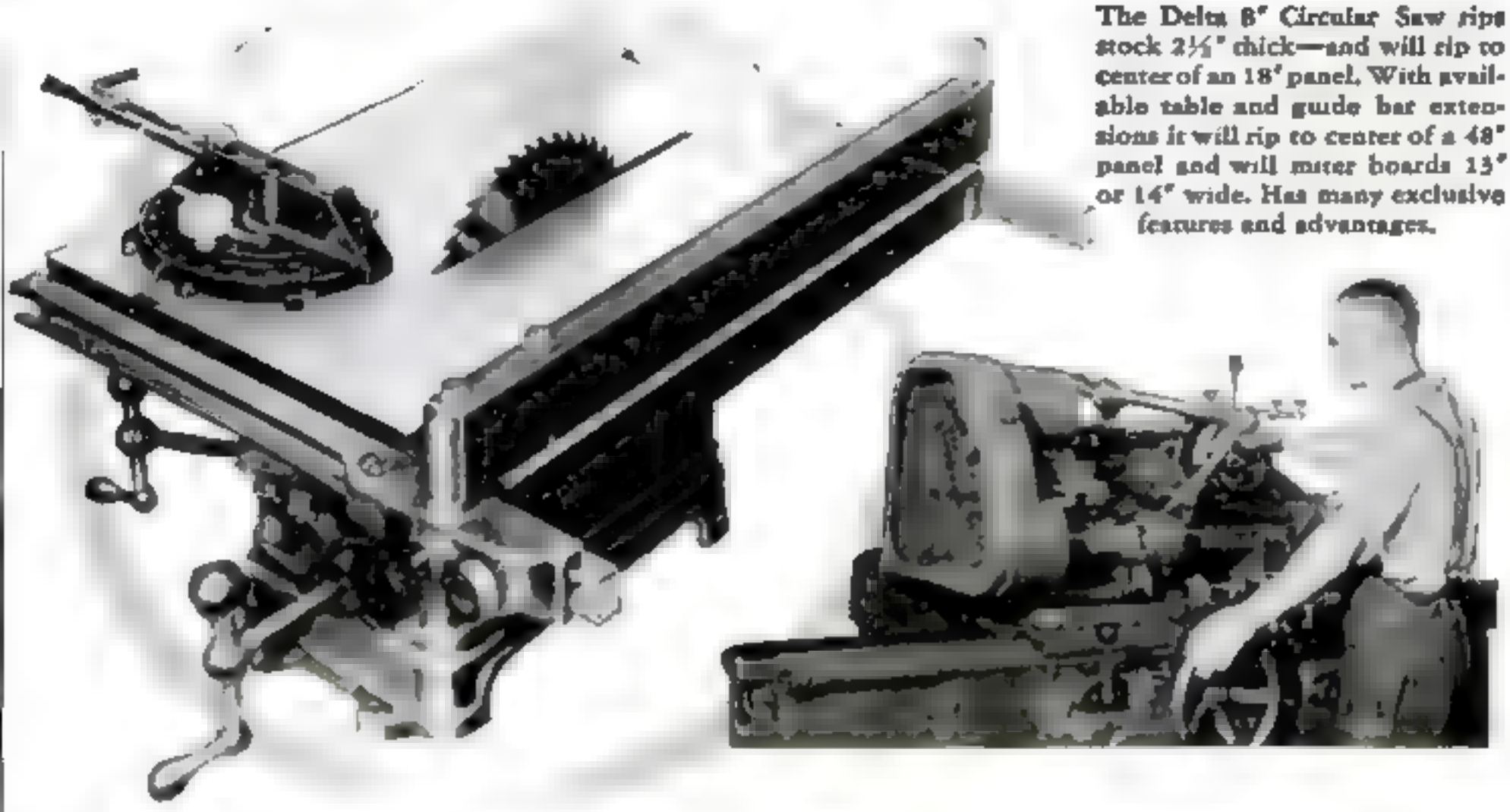
The steel shortage had held up the Toccoa building development, but shows no sign of stopping LeTourneau, who can get all the material he needs for his No. 1 defense industry. At 53 he is still popping ideas. He had a startling one last summer.

"They've been too busy figuring how to build 80-ton tanks like the Germans," he said. "Let's not bother with 80-tonners. Let's make them 180-tonners and blow all the 80-tonners to pieces."

Question Bee Answers—Page 126

1. b	2. b	3. b	4. b
5. b	6. a	7. b	8. c

How "PRECISION GRINDING" makes a *better* Circular Saw



The Delta 8" Circular Saw rips stock 2½" thick—and will rip to center of an 18" panel. With available table and guide bar extensions it will rip to center of a 48" panel and will miter boards 13" or 14" wide. Has many exclusive features and advantages.

ALL ARBORS, spindles, bearing seats, etc. on Delta machines where accuracy to close limits is important, are ground to size. Turning to size is "good enough" for many manufacturers but not for Delta machines! As shown in this illustration to the right, Precision Grinding to size, after turning, is an extra operation. It costs more money—and you can't see it as you can see nickel plating on the outside of a machine. But in a bearing or bearing seats, it provides a fit that is "all over" instead of only on a comparatively few high spots. This means that ball bearings do not become loose in service. Precision grinding produces a closer fit to more exacting tolerances, which means that fits are uniformly good and that true interchangeability is obtained.

The extra accuracy obtained by precision grinding may be visualized when it is realized that the ordinary variation or tolerance on Delta arbors and spindles is three-ten-thousandths of an inch, and in many instances this tolerance is held to one ten-thousandth.

Send for Delta Catalog

Write for the new Delta catalog which is a complete guide book to power tools. It not only lists the entire line of Delta "Quality" wood and metal working tools—but shows you the important points to look for in all power tools. It illustrates and explains the advantages of the many hidden features of design and construction that make for long, better service in power tools. (Also send for Project Book 8 crowded with new projects, including working drawings, photographs and full instructions.)

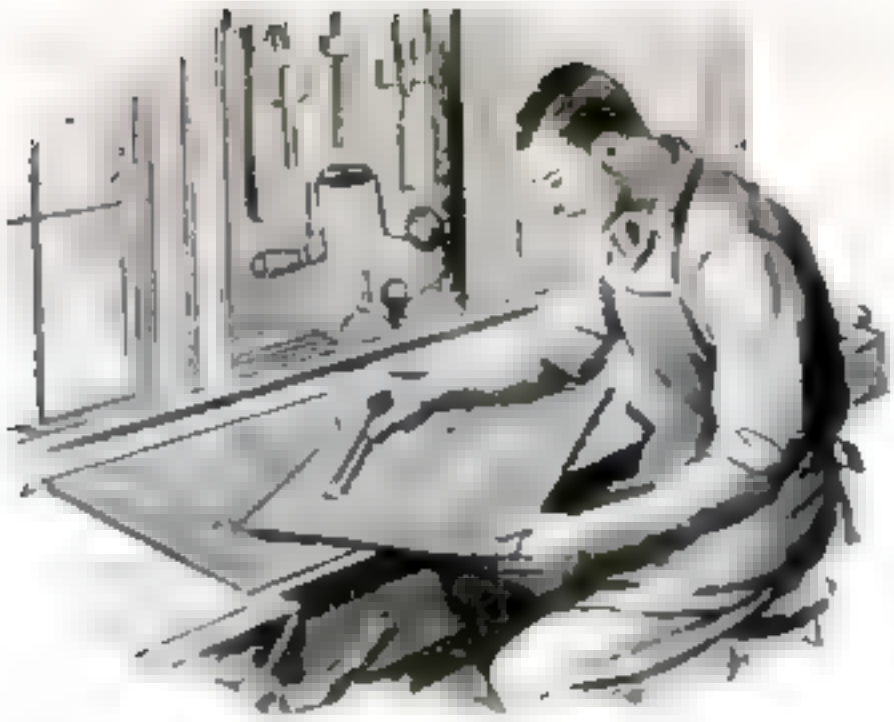
DELTA MILWAUKEE

The Delta Manufacturing Co., (Dept 683-A)
600-634 E. Vienna Ave., Milwaukee, Wis.

Gentlemen: Send me the latest Delta Catalog listing the complete line of Delta Lathes, Circular Saws, Band Saws, Jointers, Scroll Saws, Shapers, Sanders and Drill Presses. ☐ I enclose 10c (stamps or coin) for which please send me the new Delta Project Book No. 8.

Name .....
Address .....
City ..... State .....

☐ Check here if you are a Delta user now.



Gift Blueprints May Help Solve a Xmas Problem

IF YOU'RE puzzled as to what to give a workshop enthusiast, if your Christmas budget isn't stretching as far as it should, if you're up against that last-minute shopping question or looking for a "different" gift, here's the answer to your problem: Give shop blueprints! Good plans simplify the building of worth-while projects, prevent errors, help avoid waste of materials. Any hobby worker will be glad to start a blueprint library.

POPULAR SCIENCE will rush orders through within 24 hours after they are received at this office. Make your selections from the following list of outstanding projects or, if the plans you want are not listed, send a stamped, self-addressed envelope for our complete blueprint catalog.

FURNITURE

Coffee Table with Spiral legs, 245A $ .25
Colonial Writing Desk, 3' 6" high and 3' 8" long, 21..... .25
Combination Bench and Tilt-Top Table, (no turning), 11..... .25
Early American Round-Top Stand, 191A..... .50
Early Colonial Pine Chest, 32" long, 21" deep, 24" high, 308A 25
Fireplace Screen (brass and wrought iron), Bedside Cabinet, and Trinket Box 389A 25
Fireside Bench, Colonial, 187A-188A .50
Hanging Wall Cabinet, 9½" by 24" by 41¾", 280A .25
Modernistic Folding Screens, 4 designs that require no turning, 91 25
Sewing Cabinet of 1812, 178A .50
Six-Footed Coffee Table, 14" high; top is 14" by 26", 327A..... .25
Tavern Table and Scroll Mirror, 105..... .25

MODELS

Clipper Ship SOVEREIGN OF THE SEAS, 20½" hull, 51-52-53-R 1 00
Clipper Ship in a Bottle, 121-122..... .50
Cody Coach 13" long 144-145-146-R 1 00
CONSTITUTION ("Old Ironsides"), 21" hull, 57-58-59-R 1 00
Elizabethan Galleon REVENGE, 21" hull, 30" long, 25" high over all, 206-207-208-209..... 1.00
Gettysburg Cannon, 292-293A ..... .75
Harbor Tugboat, full hull model, 11⅝" long, 284.. .25

(Continued on page 224)

Plans for the Workshop

(Continued from page 223)

Miniature Fleet of Nine Modern U. S. Fighting Ships (full-size plans and instructions in booklet form), 372-R ..... .50
New Bedford Whaleboat, with complete equipment, 14" long, 326-R ..... .50
NOURMAHAL, power yacht, 8½" hull, 270 ..... .25
Ocean Freighter, 14" hull, 271 ..... .25
U. S. Battleship TEXAS, 3' hull, 197-198-199-200 ..... 1.00

BOATS

Cabin Cruiser, 17' long, weighs 750 lb., may be used with 3 to 10 h.p. outboard or inboard motors, 356-357-358-359-R 1.50
Camper's Utility Boat, 11' 2" long, canvas-covered, for outboard motor or rowing, 281-R ..... .50
Canoe, 16' canvas-covered kayak, can be used with sail, 192-193-194-R 1.00
Canvas-Covered Duck Boat, 13' 6" long, 279-R ..... .50
Combination Boat, 15' hull, for use with sail, outboard motor, or oars, 131-132-133-R 1.00
Cruising Sailboat, 19' long, weighs 700 lb. Marconi sloop rig, can be used with 1 to 4 h.p. inboard or outboard motor, 400-401-402-403-404-R 2.00
Family Runabout, 13' 6" long, weighs 275 lb., for outboards from 1 to 60 h.p., or oars, 378-379-380-R 1.50
Fisherman's Outboard Boat, 9' 3" or 11' 6" long, weighs 115 or 160 lb., for motors from 3 to 18 h.p.; can also be rowed, 344-345-R ..... .75
High-Speed Boat for Small Outboard Motors, 7' 11" long, 257-R ..... .50
Motorboat-Rowboat, 13' long, with decked hull for use with outboard or inboard drives, 147-R ..... .50
Plywood Dinghy, 9' 7" long, weighs 60 to 75 lb., can be rowed, sailed, or used with small outboard motor, 357-358-R ..... .75
Racing Runabout, 13' stepless hydroplane for outboard motor, 261-262-R ..... .75
Racing Sailboat BLACKCAT, 13' 4" long, weighs 250 lb., Marconi rigged, 321-322-323-R 1.00
Sectional Rowboat, 9' 8" long; can be used with small outboard, 340-341-R ..... .75
Sport Runabout, 9' 8" long, for small outboard motor, weighs 100 lb., 309-310-R ..... .75
Utility Rowboat, 13' long; can also be sailed or driven by outboard motor, 224-R ..... .50

MISCELLANEOUS

Bird and Animal Patterns, 56 ..... .25
Bronze Hammer Rolled-Edge Metal Tray, Table Centerpiece for Easter (rabbit hitched to wagon), 407A ..... .25
Five-Piece Desk Ensemble (letter rack, blotter, letter opener, etc.), Nautical Lamp (resembles engine-room telegraph), 410A ..... .25
Folding Wall Brackets (turned), Treble-Clef Bud Vase (metal or plastic), Vacuum Cleaner Attachment Rack, 408A ..... .25
Outdoorsman's Lightweight Trailer, 10' long, 4' wide, 4' 9" high, kitchenette on back, 300-301-R ..... .75
Turned Costume Jewelry and Solid Model of Argonaut Pirate Flying Boat, 275A ..... .25
Turned Table Lamp, Derringer Pistol, and Weather Vane (woman watering garden), 408A ..... .25
Workbench for Home Shop, 24" by 58" by 34¼" high, 405 ..... .25

Popular Science Monthly
353 Fourth Avenue, New York, N. Y.

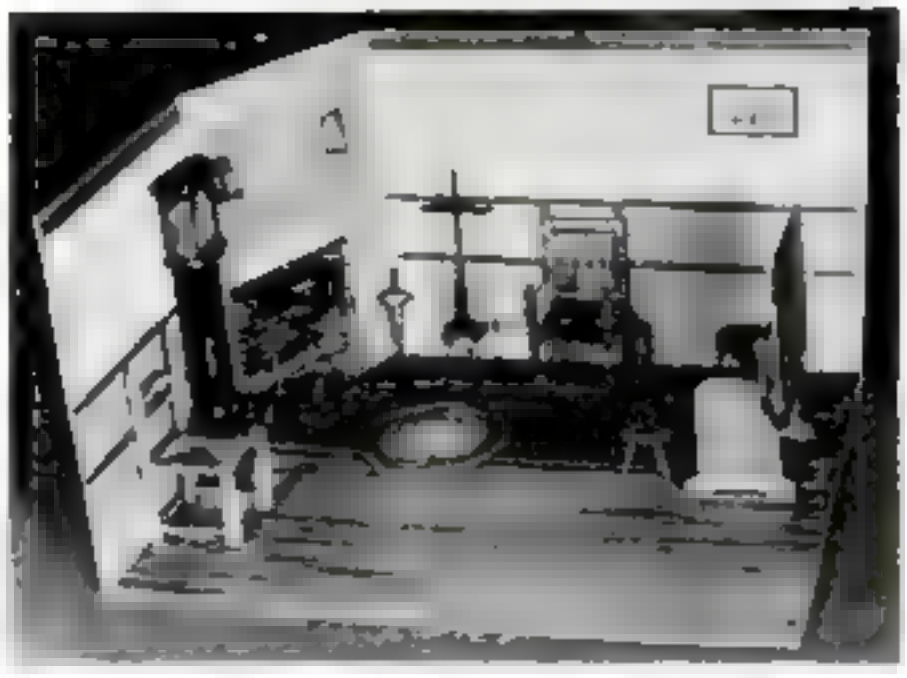
Send me the blueprint, or blueprints, numbered as follows

I am inclosing..... dollars.....cents

Name .....

Street .....

City and State .....
(Please print your name and address very clearly)



18. Furniture kit for Colonial living room, $1.00

Easy-to-Build Furniture Kits Make Ideal Xmas Gifts

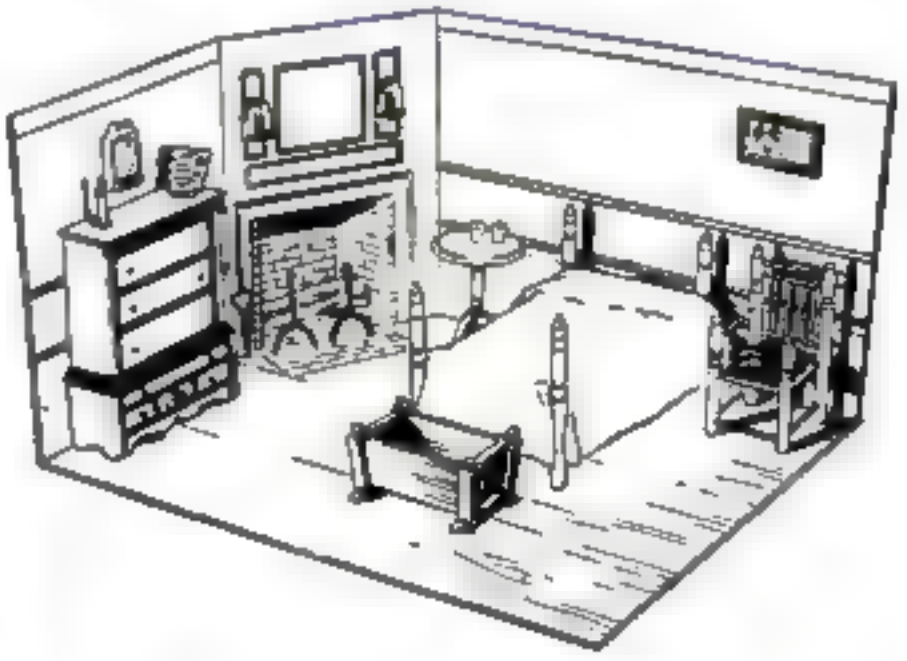
FURNISHING scale-model rooms is a hobby as fascinating as it is instructive. POPULAR SCIENCE now offers four one-dollar kits of authentic Colonial furniture, all scaled 1" to the foot. These include turned legs, stamped basswood from which other parts can be cut, die-cast metal fixtures and utensils, and instructions, but no walls or floor.

All the family can join in the fun. The craftsman will find his skill challenged in making scale-sized molding, paneling, windows and the like. Women will enjoy adding miniature crocheted rugs, bedspreads, and curtains. The finished pieces make charming doll-house furniture.

The following is a partial list of our kits. For a complete list, send a self-addressed, stamped envelope.

R. U. S. cruiser TUSCALOOSA, 11⅜" long. $1.10
Q. Privateer SWALLOW, a Baltimore clipper, 12½" hull 20" overal 5.25†
SS. Fishing schooner BLUENOSE. 17⅛" hull. 22" over all 5.30†

(Continued on page 227)



15. Kit of furniture for Colonial bedroom, $1.00

Home and Workshop Index for All 1941 Issues

YOUR back issues of POPULAR SCIENCE will be worth more to you, and their wealth of information will be more quickly available, if you have on hand a copy of the Home and Workshop Annual Index for 1941. All articles on woodworking, craftwork, home building, house repairs, model making, new shop ideas, radios, automobile servicing, and so forth are not only listed alphabetically, but also cross-indexed for easy reference. Simply send 10 cents to Popular Science Home and Workshop Index, 353 Fourth Avenue, New York, N. Y., inclosing a long, legal-size (No. 10) envelope addressed to yourself. A limited supply of the 1940 index is still available. Send 20 cents if you wish indexes for both years.

Model Construction Kits

(Continued from page 226)

138.	Motor Torpedo Boat P T. 10; a 13" exhibition model (not a working model) shaped hull, propellers, ventilators, etc.	5.00†
98.	New Bedford whaleboat, with complete equipment 14" long	2.95†
13.	Miniature Early Colonial Kitchen 21" long 7" high and 5" deep walls, ceiling and floor printed in four colors on cardboard with furniture materials and fixtures	
14.	Colonial Stagecoach Inn. Same general description as kit No. 13	2.00
16.	Colonial Kitchen Furniture; parts for furniture and finished die-cast fixtures; room not included	1.00
17.	Colonial Dining-Room Furniture; parts for furniture and finished die-cast fixtures; room not included	1.00

Note: If you live west of the Mississippi River add 25 cents to prices marked with a dagger (†)

Popular Science Monthly, Dept. 12A
353 Fourth Avenue, New York, N. Y.

Please send me Kit ..... for which I inclose $ ..... (or send C.O.D. ☐)

Name .....

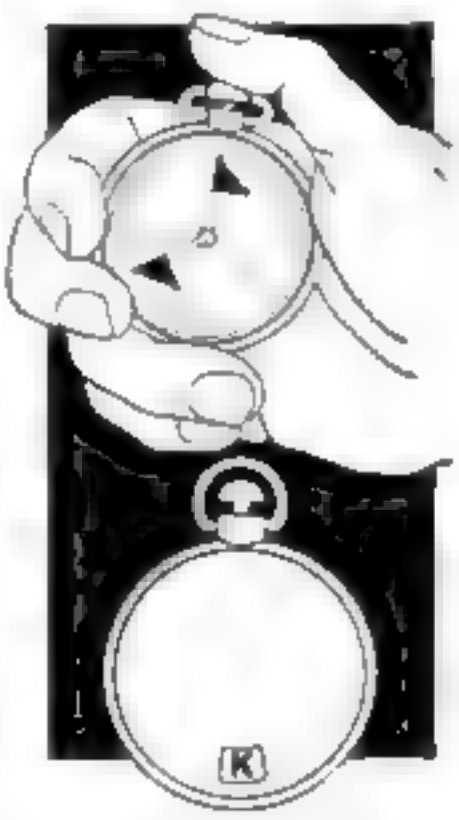
Address .....

City ..... State .....
(Please print your name and address very clearly)

You save the C.O.D. charge by sending your remittance with this order. Remit by money order, check, or registered mail. This offer is made only in the United States. Also see note above.

With the Inventors

EFFORTLESS travel over the ice is made possible by motor-driven ice skates invented by Oren F. Russell of Palmer, Wash. In the midsection of the skate, a sharp-edged helical blade turns in contact with the ice. Provision is made for adjusting it to give just the required degree of "bite." Motive power is furnished by a midget gasoline motor mounted at the back of each skate. Hand controls, like those of a motorcycle, may be used to regulate the speed of the motors, as illustrated. For trips across large frozen areas, the putt-putting skates are declared a really practical innovation as well as an interesting novelty. . . . PRACTICE IN READING FLAG SIGNALS, using the international semaphore code, is offered by F. W. Cattanach of Cranford, N. J., in the form of an ingenious device resembling a watch. Each time a button on its "stem" is pressed, a pair of flags on the face move to the proper position for one of the letters of the alphabet. First the user tries to identify the signal at sight. Then he can check his accuracy by looking at the back of the instrument, where the corresponding letter appears in a peep hole. A replaceable cam, in the "works" of the practice aid, determines the sequence in which the signals appear. One cam, for example, may present all the code symbols in random or scrambled order. Another cam may spell out a complete message, while a third may produce a coded message to be deciphered. . . . GOODS THAT WOULD BE INJURED by dampness

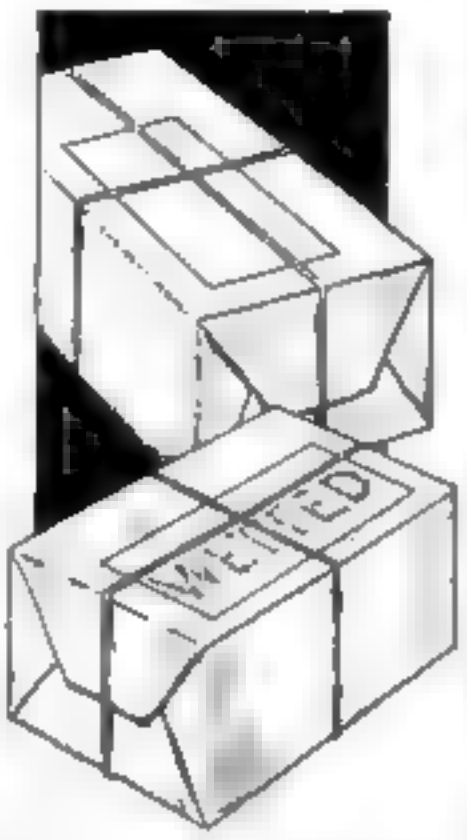


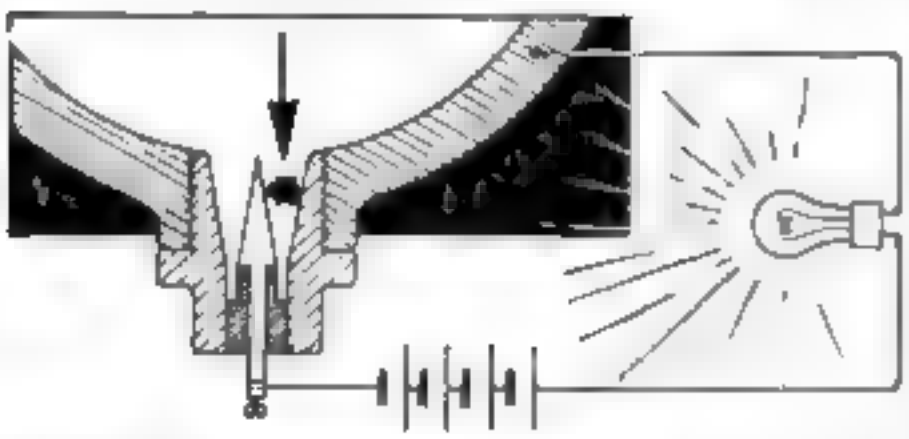
(Continued on page 229)

With the Inventors

(Continued from page 228)

may now be stored in containers with tell-tale labels, invented by Marjorie G. Snelling of Allentown, Pa. If they are stored in moist places, an ordinarily invisible chemical preparation brands the packages with the word, "Wetted." A number of suitable compositions for the purpose have been developed. One is a mixture of a deliquescent, or water-absorbing, chemical with a colored dye that will stain the wrapper. Another combines an alkaline deliquescent agent with the chemical "indicator" known as phenolphthalein, which will turn pink or red when the mixture is moistened. Or, when the wrapping itself is colored, its tint may be bleached by a suitable moisture-sensitive reagent. According to the amount of moisture that is harmful to the product, a range of deliquescent agents has been worked out that will respond to relative humidity from below 40 percent up to 98 percent. . . . LOOSE METAL PARTICLES which may cause serious damage, by finding their way into the oiling systems of power plants, are ingeniously detected by an alarm system worked out by a Netherlands inventor. In his scheme, a plug is screwed into the lowest point of oil circulation. Facing inward from this plug is an insulated, tapered metallic point. Terminals of a battery and warning lamp are connected respectively to the pointed insert and to the frame of the machine, which serves as an electrical ground. Any heavy fragment of metal, as indicated by the arrow in the ac-



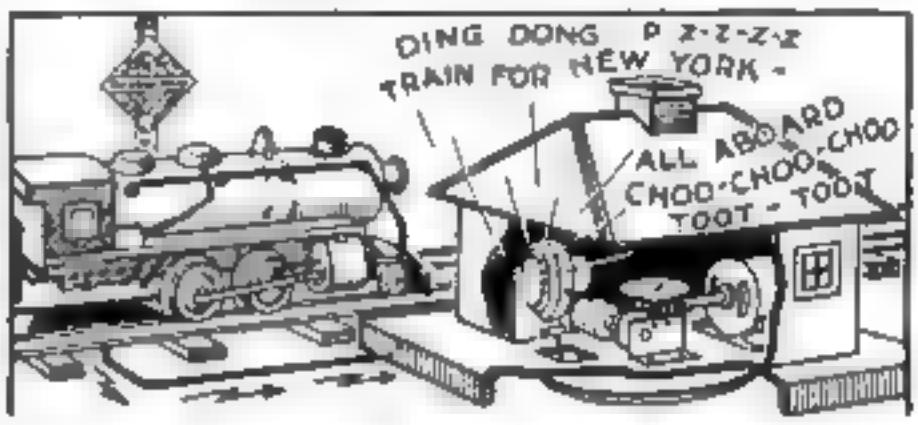


(Continued on page 230)

With the Inventors

(Continued from page 229)

companying view, will settle in contact with the point and also with the frame. By doing so, it will close the electrical circuit and the lamp will glow, betraying its presence. The automatic watchman obviates the need for periodical shut-downs and inspections,



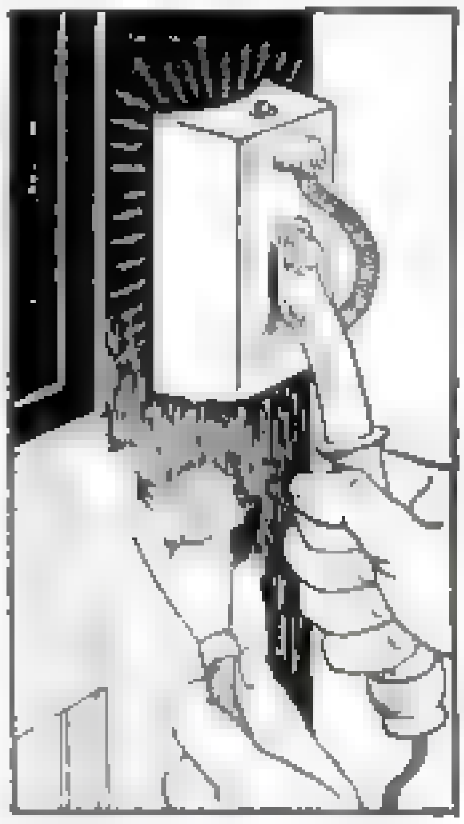
with the attendant loss of large quantities of oil. . . . NEW SOUND EFFECTS for toy electric trains, operating entirely automatically, are provided by William R. Smith of Philadelphia, Pa. When a steam-type model reaches an insulated section of track, depriving it of power, it comes to a standstill before a depot. An engine bell clangs and the familiar hissing of air brakes is heard. An imaginary station master announces the name of the express, its destination, and way stations. After a final cry of "All aboard!" the train realistically puffs on its way, to the accompaniment of a tooting whistle. The secret of the sound effects is a phonograph disk concealed within the station, and bearing the recorded sounds just described. The turntable is synchronized with electric connections for stopping and starting the train, and both are controlled by the movement of the train itself. Whenever desired, a hand switch throws the system out of operation and the train passes the station without stopping. . . . SIMPLY BY PUTTING an angular bend in the semicircular handle of a paint can, as shown, A. B. Baisden and W. A. Lentz, of Belleville, N. J., have provided marked advantages. When the can is hooked to a lad-

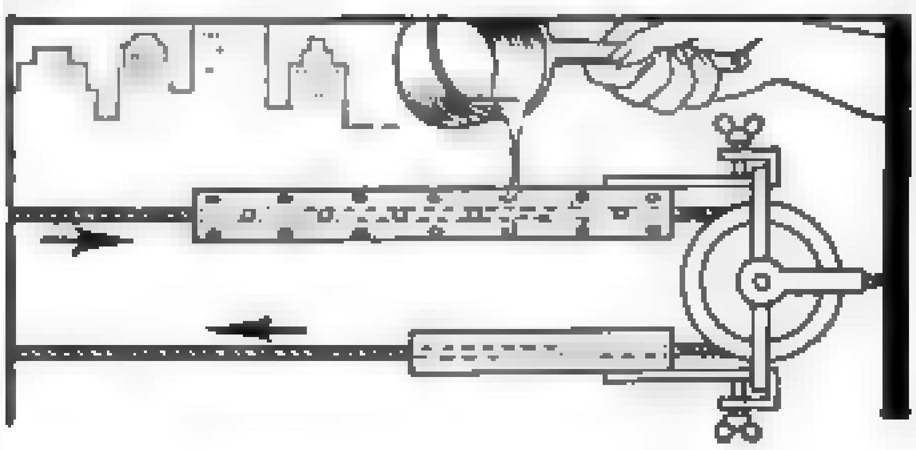
(Continued on page 232)

With the Inventors

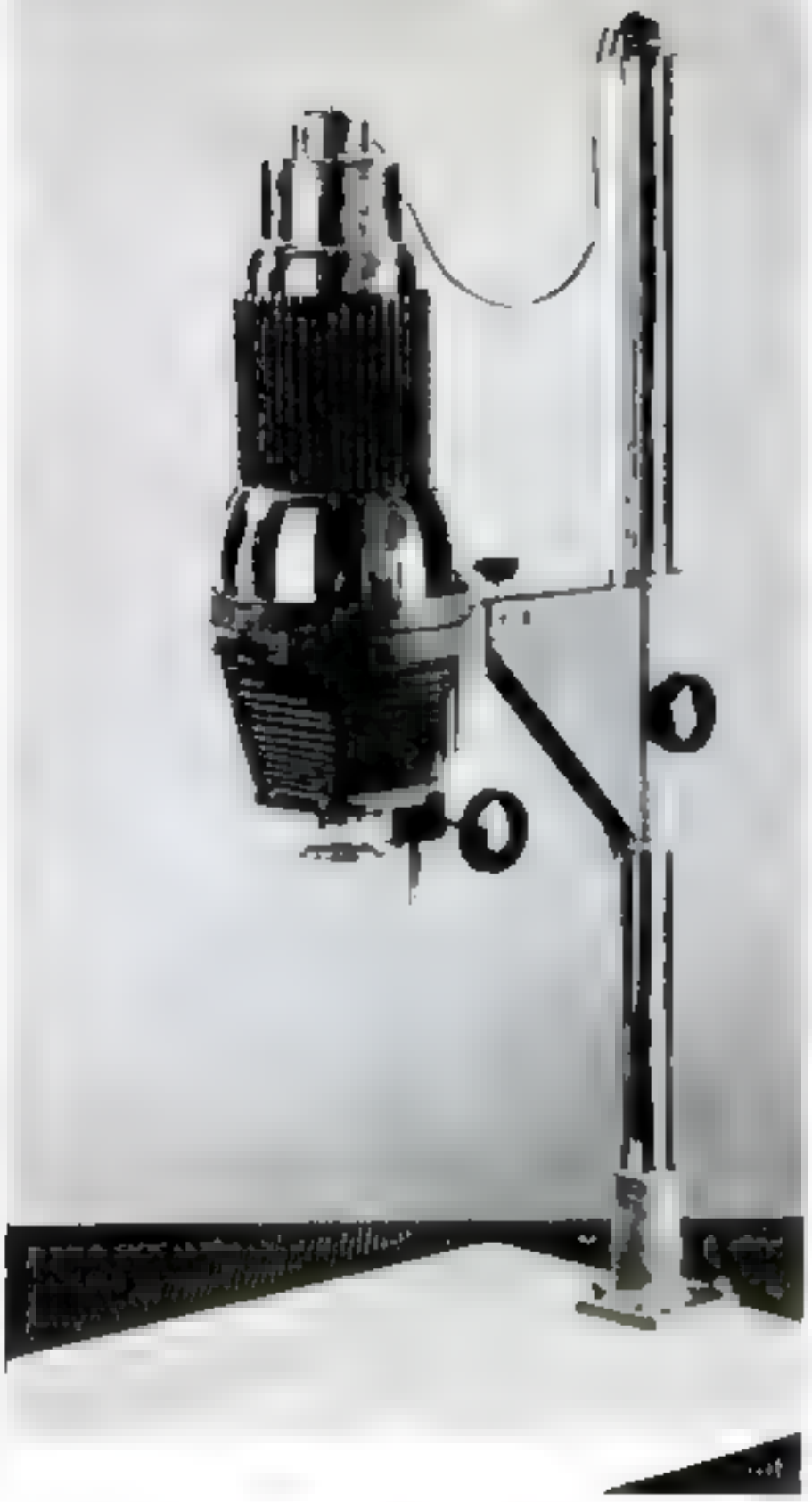
(Continued from page 230)

der rung, the offset handle swings out of the way, leaving the whole mouth of the container unobstructed for insertion of the brush. In shipping, cartons of mimimum size may be used, for the handles lie flat against the sides of the cans. There is no need to remove the handles and later replace them, as is common practice. . . . REPLACING THE DANGEROUS PRACTICE of using a blowtorch in removing old paint, a new tool applies electric heat from a resistance coil mounted in a block of refractory material. When this implement has passed over a layer of paint or varnish, the coating is so thoroughly disintegrated that it is readily removed with a scraper, as shown. The heating element is directly exposed to the wood in the hollow interior of its working face. . . . KEEPING AN OUTDOOR CLOTHESLINE CLEAN in city surroundings no longer is a hopeless task. An automatic cleaner devised by Thomas Esposito, of South Orange, N. J., is said to solve the problem. His invention consists of a pair of cylindrical metal tubes through which the line passes. The longer tube, perforated so that water or other cleaning fluid can be supplied, collects soot and dust when the clothesline is drawn through it, upon a core of sponge rubber. A shorter





tube, with a core of felt, then dries the line. In both tubes, the casing and core are slotted and expandable, so that the clothesline may be removed or replaced at will. The cleaning element itself may be detached.



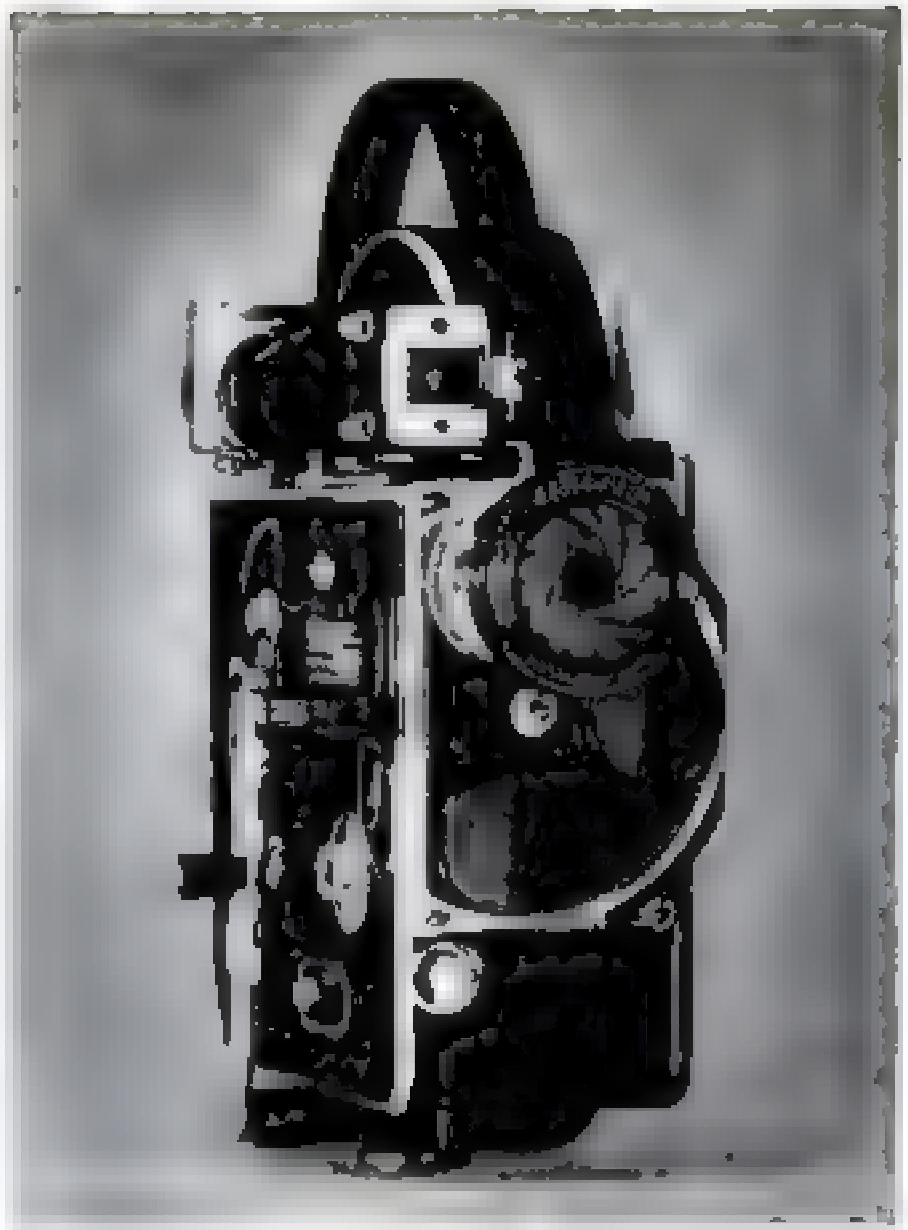
Enlarger for Small Negatives Supplies Maximum Lighting

PROVIDING maximum illumination through the use of a double condenser system, this enlarger has also a sliding head assembly, light-tight lamp house, and revolving, glassless negative carrier, available in sizes from 35 mm. to 2¼" by 3¼". The enlarger is designed for either standard bench or table use or for mounting on a special tripod.

Silver Board Used as Film Screen

WHEN the budget fails to provide for the purchase of a glass-beaded screen for showing home movies and color transparencies, a sheet of sign painter's silver board makes an effective substitute. A piece 30" by 45" is ample. The board also may be used as a reflector to lighten the shadows when taking pictures.—ED REYNOLDS.

Please mention POPULAR SCIENCE *when writing to advertisers.*



Vignetter for 16-mm. Cameras Completely Closes Iris

AN IRIS vignetter for amateur movie cameras that has the advantage of closing down completely is now on the market. After the iris closes, an arm drops into place over the last point of light and completely blacks out the circle. By means of the device, which fits most popular 16-mm. cameras, a scene may be faded out completely; and in cameras having a back-winding mechanism, lap dissolves may be easily made.

Adhesive Mounts for Photos

DRY mounting sheets, coated on both sides with adhesive and protected by thin wax paper, make it easy to mount photographs. One side is cleared of its covering, and the photograph pressed firmly against it. Then it is trimmed to size, and the other wax paper removed, leaving the print ready to be pressed in place on a page in the album.

100X TELESCOPE LENS KIT $1.95

100 Power Complete Lens Kit

Make your own high powered telescope in one evening of easy work. All optical parts completely finished for 6 ft. long refracting telescope. Kit contains 3" diameter 75" F. L. ground and polished objective lens and two 1¼" dia. astronomical eyepieces 50X and 100X. See the mountains and craters on the moon, the ringed planet Saturn, the moons of Jupiter, double stars, etc. Complete lens kit with full directions for mounting at the special price of only $1.95 postpaid. Prompt shipment.

BROWNSCOPE CO., Dept. 61, 125 W. 45th St., New York.

GET A "PLUG-CHEK" AUTO-LITE SPARK PLUGS

SHIP MODEL SERVICE

Mr. Pratt, our Model Consultant, will advise you FREE of charge.
A complete line of all standard kits and fittings always on hand.
Also All Types **FISHER** Model Yacht Fittings

JAMES H. INS & CO., INC. Est. 1832
320 State Street Boston, Mass.

BARRON ROTARY WOOD PLANER · PLANES · PANELS

RABBETS · MORTS · TENONS · FITS ANY SMALL PRESS

$7.50 READY TO USE

A precision safety tool. Planes to right smoothness. Eliminates need for high priced planer or jointer. Fits any ½ h.p. or larger drill press. Indispensable. Thousands in use. At your dealer or write for literature. Shipped prepaid on receipt of $7.50. Positive money back guarantee.

BARRON TOOL CO., 338 Architects Bldg., DETROIT, MICH.

PLATING KITS ELECTROPLATE with BRUSH

NICKEL—CADMIUM—COPPER Etc. Kits only $1.50 each. SILVER Kit $2.00. Thousands in use in workshops and factories! Satisfaction Guaranteed or money refunded! (U. S. Pat. Nos. 2061581, 2061582 Cons. 366307, 2083041). See your dealer or order direct! RAPID ELECTROPLATING PROCESS, Inc. 1414-S So. Wabash Ave., Chicago, Ill.

$1.00 POSTPAID

SIX SCOTTIES TO WHITTLE

A new Kit containing material for whittling SIX interesting little Scottie dogs, each in different characteristic pose. Each Scottie is about 2 inches long and the six wood blocks supplied are ready cut to the correct outline. Nothing else needed but a pocketknife. Complete Kit containing 6 shaped blocks, paint and brush, pocket sharpening stone, material for eyes, and complete illustrated step-by-step instructions will be sent for only $1.00 postpaid in the United States or Canada. Get started in this new Hobby NOW. It's easy with this new Kit.

POPULAR SCIENCE MONTHLY Dept. 12
353 Fourth Ave. New York, N. Y.

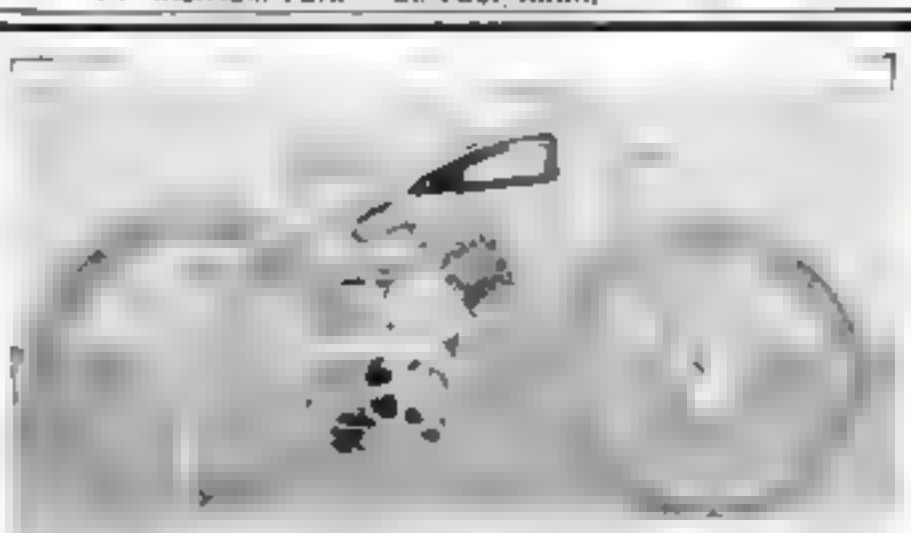
SKI ACTION

Ski action demands sturdy, well designed skis! That's why most experts in America ski on Northlands. Only Northland offers you finest woods, craftsmanship, and modern designing. Northlands make you ski better.

YOU NEED THIS 48 PAGE SKI BOOK!

84 Illustrations, edited by Schneider. Send 10c or write for FREE folder.

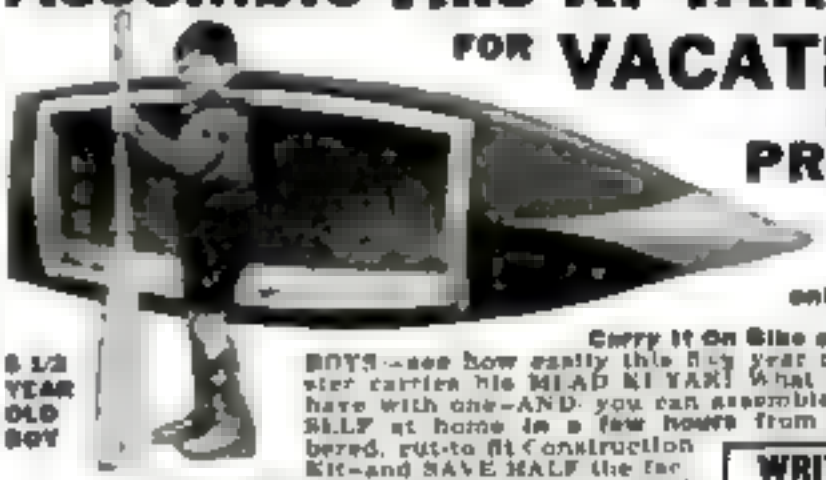
NORTHLAND
World's Largest Ski Manufacturers
94 Merriam Park — St. Paul, Minn.



"WHIZZER" Bicycle Motor Quiet, Dependable. 4-cycle 1½ h.p. Bicycle structure not weakened. Center of gravity unchanged. Looks like motorcycle. Easily installed. Further information write Whizzer Sales or send $39.95 for immediate delivery. Terms if desired. Special attention given to holiday orders.

WHIZZER MOTOR SALES CO.
8000 Sunset Blvd. Los Angeles

Assemble This KI-YAK AT HOME FOR VACATION OR PROFIT



Weighs only 20 lbs.

8 1/2 YEAR OLD BOY

Carry It On Bike or By Hand

BOYS—see how easily this 8½ year old youngster carries his MEAD KI YAK! What fun you'll have with one—AND you can assemble it YOURSELF at home in a few hours from our numbered, cut-to-fit Construction Kit—and SAVE HALF the factory built cost or sell it for big profit! Tell DAD about this educational money making project! Double Paddle or Oars now included with Ki Yak. Write NOW for FREE circulars showing nearly 100 beautiful photos of Mead K Yak sailing, paddling and with motor. Low introductory Factory-to-You Prices.

MEAD GLIDERS, 15 S. Market, Dept. O-12, Chicago

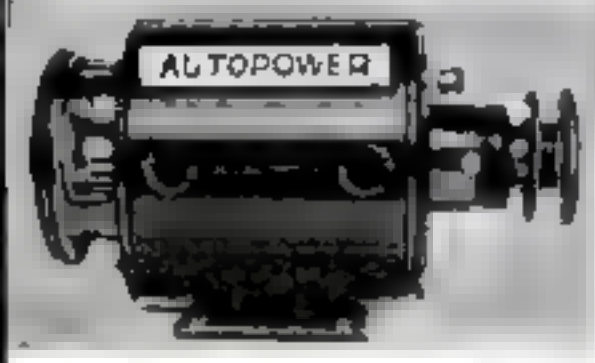
WRITE for Lavishly-Illustrated FREE Circulars!

When Writing Advertisers
Please Mention POPULAR SCIENCE

BRONZE FOUNDRY Schools and Home Workshops

Make your own castings of aluminum, copper, bronze, silver. Foundry sets are available in three sizes including 2100 Deg. F. Blast Furnaces. $17.50, $24.00, $34.50, f.o.b. Kansas City. Free Circular.

KANSAS CITY SPECIALTIES CO.
P. O. Box 6022, Dep't S-28 Kansas City, Mo.



TURN SCRAP INTO MONEY

AUTOPOWER tells you how in plain, easy, simple and illustrated instructions that anyone can follow. Change auto generators into useful, practical A C and D C generators and motors with voltage from 2 to 1,000 volts, for power, light, welding, radio, sound, etc. No previous experience nor special tools needed. Generators can be driven by wind, water, fan belt, etc. Already used and endorsed by thousands. Send for your copy of "AUTOPOWER." Only $1.00 postpaid.

AUTOPOWER, INC. 2125 Pine St., St. Louis, Mo.

Pruned Branches Bundled for Easy Disposal

HOW to dispose of a large pile of pruned branches is often a problem. One good way is to cut all the lateral branches off large limbs and lay them across a length of old clothesline or other rope. Tie a slip knot, draw the rope tight around the bundle, and knot it securely. Each bundle is then easily handled and takes only a small space if it has to be kept for a time before being hauled away. This is also a good method of getting rid of hollyhocks after they are through blooming, and of grape vines and annuals that have been killed by frost.—G. C. BAIR.

Timesaving Way to Prepare a Sheet of Ground Glass

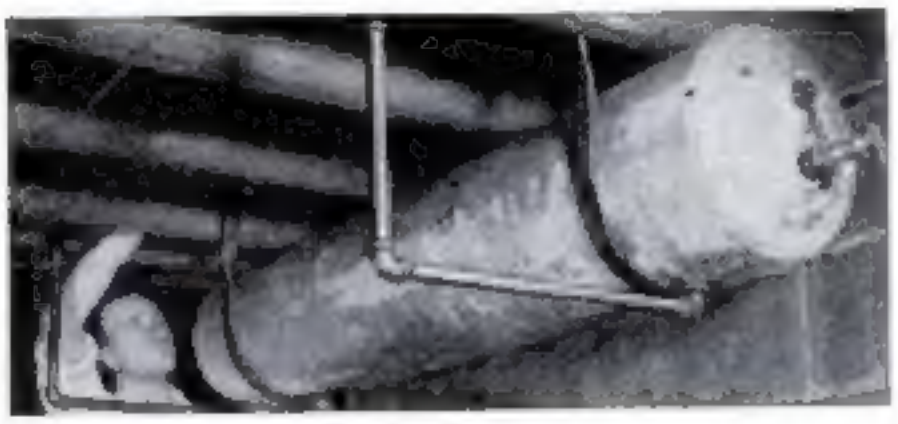
TIME can be saved in making a sheet of ground glass by a slight variation of the usual method, which is to place the glass on a level surface, sprinkle a small amount of abrasive powder over the surface, wet it with water, set another sheet of glass on top, and rub the two together in a circular motion. A good deal of rubbing has to be done before the glass is evenly ground. To avoid much of this work, prepare the glass in the same way, but do the rubbing with a piece of glass about 1" square. To the back of this attach a rubber vacuum cup, or fasten a small block of wood with a drop or two of sealing wax. It will be found that the small glass will grind into the hollows and produce an equally good ground glass with less effort.—DICK HUTCHINSON.

Portable Electric Welder Thaws Underground Water Pipes

FARMERS and other rural residents, when they find themselves unable to thaw out frozen underground water pipes by ordinary means, should keep in mind the service offered by many owners of portable electric-welding power plants. One operator, who responds to pipe-thawing calls with a power plant mounted on a truck chassis, estimates the average time required to re-establish water flow from well to pump at about 15 minutes for a run of 50' to 100'. With suitable resistance thrown into the circuit, he connects one power lead to the well end of the frozen pipe and the other lead to the pump end. A current of 400 amperes at 80 volts usually thaws the pipe. An iron pipe, due to its higher resistance, will thaw out more readily than a copper pipe—J. MODROCH.

This One

KZX7-BFJ-N1N9



Tank and Check Valve Control Water-Pressure Fluctuations

IF YOUR house water system is subjected to wide pressure fluctuations resulting in small flow or the cutting off of the supply entirely when the neighbors are drawing water, you can install a simple and inexpensive system to overcome the annoyance. The system consists of a check valve and a range boiler installed between the water meter and the first branch in the house system as shown above .

The periodic pressure from the main compresses air in the tank. The check valve stops the water from returning to the main when the pressure falls below that of the tank. With only a 20-lb. normal main pressure and a 30-gal. tank, about 15 gal. will be available at the first-floor faucets after the main pressure has fallen to zero. A relief valve should also be installed if a water heater is used in the house.—T. P. S.

Adding Water to Batteries in a Small Stationary Power Plant

IN MAINTAINING stationary storage batteries, the addition of water to replace evaporation is often a bothersome detail. It therefore pays to get a jug of the type generally used around service stations for filling automobile batteries. This container keeps the distilled water clean and pure, and the exact amount may be added to each cell without spilling a drop.—RAY BLAIN.

Please mention POPULAR SCIENCE *when writing to advertisers.*

They Work Together *for* YOU

YES, these two men are working together for you, a prospective user of South Bend Lathes. Together a shop foreman and a designer are finding the answer to one of the problems that must be solved to maintain South Bend standards of quality. Their friendly cooperation is typical of the shoulder to shoulder teamwork of our employees. This coordination of effort contributes much to the service and satisfaction you will receive from a South Bend Lathe.

All of us, here at South Bend, are working together for you—and for National Defense. Production schedules have been doubled and redoubled. But no sacrifice in quality has been made—nor will there be any lowering of our standards.

South Bend Lathes are made in five sizes: 9", 10", 13", 14½" and 16" swing, Toolroom and Manufacturing types. Each size is available in several bed lengths. Complete line of practical attachments, chucks and tools.

South Bend 16" Toolroom Precision Lathe

SOUTH BEND LATHE DEALERS

Boston, Mass.....South Bend Lathe Works*
Buffalo, N. Y.....R. C. Neal Co., Inc.
Chicago, Ill.....H. J. Volz Machinery Co.
Cleveland, Ohio.....Reynolds Machinery Co.
Detroit, Mich.....Lee Machinery Co., Inc.
Indianapolis, Ind.....Marshall & Huschart Mchy.
Kansas City, Mo.....Faeth Company
Los Angeles, Cal.....Eccles & Davies Mchy. Co.
Milwaukee, Wis.....W. A. Voell Machinery Co.
Newark, N. J.....J. R. Edwards Machinery Co.
New York, N. Y.....A. C. Colby Machinery Co.
Philadelphia, Pa.....W. B. Rapp Machinery
Pittsburgh, Pa.....Tranter Manufacturing Co.
St. Louis, Mo.....Colcord-Wright Mchy. & Sup.
San Francisco, Cal.....Moore Machinery Co.
Seattle, Wash.....Star Machinery Co.
*Boston Sales Office, 67 Broadway Kendall Square, Cambridge, Mass., W. H. Packard, Manager, Phone Trowbridge 6369

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 35 YEARS 830 E. Madison St., South Bend, Ind., U. S. A.

THIS COMPLETE, SIMPLE, PRACTICAL COURSE FOR SELF-INSTRUCTION WILL QUICKLY GIVE YOU

a complete mastery of

Mathematics

Complete Course and Reference Library in These Five Volumes • 598 Pages • Illustrated

An Expert Gives You His Simplified Methods

Thompson, the author of these books, is not an inary teacher of mathematics. He has had many rs experience in giving students the kind of mathtical training they need in practical work. He sents each practical method and problem in the rest and simplest way. He gets right down to the l of information that you need in your daily work. on't let appearances fool you, mathematics is *easy*. can get these books on approval and see for yourhow much enjoyment you will have while getting valuable training and solving interesting practical blems that puzzle your friends and fellow workers. o time at all you will be tackling with ease the t difficult question on this subject.

D. Van Nostrand Co., 250 Fourth Ave., New York, N. Y.

PREPARE now for an important job in America's booming defense industries—learn mathematics. Mathematics is the basic requirement of all mechanical and scientific work, and of all business or industry based on science. Without this essential knowledge even the most capable man is left behind while others forge ahead to better jobs, bigger contracts, more money. You need mathematics to understand all technical work, to supervise operations, to improve, speed up and check on your work and the work of others. Such basic training is quickly recognized today and gladly paid for. It singles you out from the crowd and gives you an advantage whether it is a matter of a job, a promotion or a contract.

Now you can learn mathematics by an easy, inexpensive and time-saving method. This very simple and extremely interesting course in book form has been prepared for you by an expert who has devoted a lifetime to teaching practical men the fundamentals of this important subject.

MATHEMATICS For Self-Study

by J. E. Thompson, B.S. in E.E., A.M., Dept. of Mathematics, Pratt Institute

MATHEMATICS FOR SELF STUDY starts right from the beginning with a review of arithmetic that gives you all special short cuts and trick problems that save countless hours of your time and make you more valuable to yourself and your job. Then these books go right into higher mathematics and show how simple it is when an expert explains it for you.

ARITHMETIC: Starting with a quick review of principles, this volume presents all the special calculation methods used in business and industry which every practical man should know. Fundamental in all computations in engineering, both military and civilian. Essential methods for rapid calculation such as is needed in firing guns, setting lathes, etc. Systems of measurement and their computation required in machine work. Hundreds of other applications to technical work.

ALGEBRA: Starting with simple practical problems, this book shows you, step by step, how to apply algebraic methods to the most complex problems. Shows how to solve problems which are involved in all military and industrial work, relating to machines, engines, projectiles, ships, planes, etc. Logarithms and slide rule, and many other practical applications.

GEOMETRY: States clearly all needed facts about plane figures, circles, polygons, etc. Covers all the topics essential in drafting and engineering. It deals at length with angles, triangles, circles, and the many other geometric figures that are basic to engineering design. Sheet metal work, so important in airplane construction, is a direct application of these principles. So also is the laying out of ship hulls, which is the major activity in ship construction. The properties of circles and spheres explained in this volume also apply directly in navigation.

TRIGONOMETRY: This volume makes easy the principles of angles and triangles, shows you how to use tables that explain their functions. Prac-

(Continued at top of next column)

MARION HUTTON
Glenn Miller's Moonlight Serenade
"rings in the new"
with Chesterfield

Best of the Year

It's CHESTERFIELD

... first for a *Milder and decidedly Better Taste* ... first for *Cooler Smoking*

...and right you are because everything in Chesterfield ... every bit of material used, is put there to give you just what you want in a cigarette ... from the Right Combination of the world's best cigarette tobaccos to top-notch manufacturing methods

MAKE CHESTERFIELD YOUR SMOKING PLEASURE OF THE YEAR *They Satisfy*